



BIBLIOGRAPHY ON SALIVA

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This volume is respectfully dedicated
to Doctor J. L. T. Appleton, B.S., D.D.S.,
Sc.D., University of Pennsylvania, and to
Captain Carl A. Schlack, Dental Corps,
U.S. Navy (Ret.).

PREFACE

With the realization that a review of the literature is a necessary part of all research, this bibliography was compiled to provide the research worker and the teacher with a thorough coverage of the literature on the subject of saliva.

The number of articles from many different scientific journals abstracted in this bibliography demonstrates the interest that investigators have shown in this subject. Many of the reports were published in journals not directly related to dentistry, which aids in bringing different concepts to light, but has made the task of searching the literature a difficult one.

The abstracts are arranged alphabetically by the surname of the senior authors. The spelling of authors' names is that which appeared in the original source. Each reference is listed as follows: author(s), title, journal, year, and abstract. In the case of articles from foreign literature, the title appears in the foreign language along with a translation and an abstract in English. In many instances the abstracts are those of the author(s).

A subject index, keyed to the author's names and to page numbers, will be found at the end of the bibliography. After the listing of a particular subject, authors' names are presented with the year of their publications, and this is followed by the page number in the bibliography where the abstract may be found. For example: Amylase, alcohol, Bang, I., 1911, p. 20.

Finally, this compilation is not intended as a textbook on saliva, but is a guide to the existing literature in this extremely important and growing area of biologic research. The coverage of the literature is complete through 1957, with additional coverage of only specific journals such as the "Journal of Dental Research," and "Oral Surgery, Oral Medicine, and Oral Pathology," through 1958.

The abstracting of articles for this bibliography was started in 1950 by the Staff of the Bibliography Section of the Science and Technology Division of the Library of Congress. The abstracts were prepared and edited by bibliographers trained in biology rather than in dentistry; for this reason they were not influenced or limited by dental concepts. This work was supported by the Office of Naval Research and the Bureau of Medicine and Surgery, Department of the Navy.

Special acknowledgment is extended to those persons who contributed infinite hours of work toward the compilation of this bibliography. We are indebted for the tedious and laborious searching of the literature performed so diligently by Dr. Clement R. Brown, Head, Bibliography Section, Science and Technology Division, Drs. Vincent Waldron and Ludmila Kasseanoff, Mrs. Ursula Muskett, Mrs. Rosamond Woodhour, and Mr. Clarence Gardner.

Particular appreciation is extended to CAPT M.G. Wheatcroft, DC, USN, and Dr. John L. Nemes, Georgetown University, for their participation in the selection of abstracts to be included in this bibliography, and to Drs. Vincent Waldron and Roman Kenk for the meticulous editing of each abstract. Grateful acknowledgment is made to Dr. Dimitrios Afonsky of the University of Rochester for the excellent indexing of this work.

Finally, especial thanks are extended to CAPT James A. English, DC, USN, CAPT William E. Ludwick, DC, USN, and Dr. Joseph F. Saunders, Office of Naval Research for the role they played in the administration of this work.



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Abels, Julius C., 1936m. DETERMINATION OF ETHYL ALCOHOL IN SALIVA. *Proc. Soc. exper. Biol. Med.*, 34 (4): 504-505.

The ethyl alcohol contents of the salivas of 30 normal individuals were estimated, by the micro and macro methods of Abels (*Proc. Soc. exper. Biol., Med.*, 34: 4. 1936), to be 0; blood values of ethyl alcohol ranged from 0 to 7 mg./100 cc. In 50 individuals in various stages on inebriation, the blood and salivary EtOH corresponded closely (average deviation, ± 10 mg./100 cc.). The substitution of salivary examinations of ethyl alcohol for the more difficult blood examinations is suggested.

*Abramov, K. T., 1947. VLIĖNIÉ CHUZHEROD-NOI SYVOROTKI NA SEKRETSIIŮ PODCHELIŮSTNOI ZHELEZY SOBAKI PRI VOZBUZHDENII PARASIMPATICHESKOI NERVENOI SISTEMY [The influence of a foreign serum on submaxillary gland secretion in the dog after stimulation of the parasympathetic nervous system]. *Med. Biŭll. Irkutsk. Med. Instit.*, 8: 60-63. *Abst.: Sovet. med. refer. Obozrenie*, 1950 (6): 83.

The action of a foreign serum on the submaxillary secretion was studied in the dog under faradic chordal stimulation which lasted 30 seconds at 15 to 20-minute intervals. After establishment of the normal salivary secretion rate, 0.1 to 1 cc./kg. of normal horse serum was injected intravenously; 3 minutes later the chorda was again stimulated. An increase in salivary secretion was observed, followed by a decrease. In the majority of animals a decrease in secretion rate followed stimulation. The author concludes that normal horse serum sharply increases the stimulation capacity of the submaxillary neurosecretory apparatus. The action of the serum depends directly on the degree of stimulation of this gland and on the length of intervals between the serum injections.

*Abramov, K. T., 1952. VNESHNESEKRETORNAĖ DEĖATEĖ NOST' PISHCHEVARITEL'NYKH ZHELEZ SOBAK PRI VVEDENII IM STRIKHNINA I NORMAL'NOI LOSHADI-NOI SYVOROTKI [The external secretory activity of the digestive glands in dogs after administration of strychnine and normal horse serum]. *Trudy Vsesoiuz. Obshchestva Fiziol., Biokhim. i Farmakol., Moskva*, 1: 45-47. *Abst.: Sovet. Med. refer. Obozrenie*, 1954 (17): 80.

The secretory activity of the gastric glands after administration of strychnine, alone or with horse serum, was studied in dogs having fistulated parotid and pancreatic glands, isolated ventricle, and intestinal loop. Experiments were made every second day; dietary conditions were kept strictly uniform. Salivary secretion was stimulated by 100 cc. of 0.25% sulfuric acid, administered tubally without notice to the animal. After establishment of the normal salivation rate, 0.13 mg./kg. weight of strychnine nitrate was injected subcutaneously, followed by intravenous injections of a similar dose of strychnine and of 0.5 cc./kg. of normal horse serum after a stable secretion rate had been registered. The salivary rate, acidity, dry residue, organic and inorganic substances and amylolytic power of saliva were determined

hourly. The strychnine injections did not stimulate the neurosecretory apparatus but did change salivary response to an adequate stimulus by increasing the salivary organic content. The strychnine-serum injections resulted in an initial increase in salivation, followed by a decrease, and on the following day a sharp inhibition of salivation; a decrease in salivary dry residue was noted. Gastric and pancreatic secretions are also discussed.

Achrap, L. K., and N. A. Podkopaev, 1930. MATERIAL ZUR FRAGE ÜBER DIE SEKRETION DER SPEICHELDRÜSEN BEIM TRINKEN VON MILCH. [Secretion of the salivary glands during ingestion of milk]. *Pflüger's Arch. ges. Physiol.*, 224 (3-4): 539-544.

Dogs, having their left parotid, submaxillary, and sublingual salivary glands fistulated, drank alternately 400 cc. of raw skim milk, skim milk to which 72 gm. lactose has been added, cooked skim milk, and whey. Results indicated that the ingestion of milk was followed by salivation having almost the same chemical properties as the digestive saliva; the quantity secreted by the mucus glands was three times as much as the saliva secreted by the albuminous salivary glands. When the dog ingested first 400 cc. water containing 4% sugar, then the same amount of water containing 10% sugar, the quantity of the saliva obtained was 1.2 cc in both cases. This proves that this "secondary" salivation was not influenced by the physical or chemical properties of the stimulant and it was most likely conditioned by the act of ingesting food.

Acree, S. F., and J. E. Hinkins, 1908. ON ABNORMALLY ACID SALIVA. *Dent. Rev.*, 22 (4): 279-305.

This study was made in humans to determine the etiology of acid saliva. Evidence suggests that salivary acidity is related and proportional to teeth erosion; that carbonic acid is not responsible for the abnormal salivary acidity. Certain mouth bacteria, e.g., *Bacillus acidilactici* [*Streptococcus lactis*], *Staphylococcus pyogenes aureus* [*Micrococcus pyogenes var. aureus*], *Sarcina lutea*, *Sarcina aurantia*, and *B. Coli communis* [*Escherichia coli*], were shown to cause the production of acid solutions of varying pH's; certain enzymes (pancreatin, amyllopsin, emulsion, maltase, diastase, and takadiastase) are, perhaps, responsible for the production of salivary acids which facilitate tooth erosion.

Adams, W. Lloyd, and V. C. Myers, 1933. INFLUENCE OF CHLORIDES AND PHOSPHATES OF SALIVA ON ITS AMYLOLYTIC ACTIVITY. *Jour. dent. Res.*, 13 (4): 311-322.

A review of the literature on salivary amylase is presented. A study was made of the relationship of amylolytic activity to the salt concentration of unstimulated saliva in subjects having comparable rates of salivary secretion. The amylolytic indices of normal individuals were found to remain remarkably constant; the indices of 2 subjects studied over a period of 5 months were found to have a maximum difference of but 4 and 5 respectively.

The influence of the chloride and phosphate content of the saliva on the amylolytic index was studied in 21 subjects. Lower amylolytic indices were noted when the chloride and phosphorus

*Not seen in the original

contents were low; higher concentrations of the 2 salts accompanied higher amylolytic indices.

The condition of the teeth and gums was also found to affect the amylolytic index; lowest indices were noted in subjects with good teeth and gums and the highest indices were noted in those with poor teeth and gums. Considerable reduction was noted in the index of 4 subjects suffering from severe colds.

Adamson, Kenneth T., 1929. THE ROLE OF ENZYME ACTION IN THE FORMATION OF DENTAL CALCULI. Austral. Jour. exper. Biol., 6 (3): 215-227.

A series of 13 experiments on man and dog was carried out to determine "whether an enzyme was present in the gingival tissues which would hydrolyze a phosphoric ester, whether the saliva contained combined phosphoric acid which could be hydrolysed by means of such an enzyme with the formation of free phosphates; and finally, as it has already been shown that blood plasma and whole blood do not contain such combined phosphoric acid, whether the enzyme would react on them in a similar manner, producing a similar result."

The methods employed were: 1) for phosphate estimation, a modification of Neumann's and Briggs methods, and another method, fully described, for the estimation of combined phosphates after a magnesium citrate mixture had removed the free phosphates from solution; and 2) for extraction of enzyme, a technique similar to that employed by Robison [cf. Cole, S. W., Practical Physiological Chemistry, Cambridge, 1946: 416].

It was found that: "An active enzyme which is capable of hydrolysing glycerophosphoric ester is contained in the human gum tissue and in the oral tissue of the dog.

"The saliva and blood serum contain phosphate-containing complexes (probably in the nature of phosphoric esters) capable of being hydrolysed by the enzyme.

"The interaction of the enzyme on these phosphate-containing complexes results in the liberation and deposition of free inorganic phosphate.

"Under favourable conditions the liberated inorganic phosphate will form concretions.

"The action of the enzyme (liberated by trauma) on the saliva may thus give rise to salivary calculus.

"The increase in free phosphate in saliva, accompanied by an increase in the copper-reducing power, on hydrolysis with 0.1 N acid points to the fact that the organic phosphate is in the nature of a phosphoric ester probably of the hexosephosphoric group.

"Human oral gum tissue does not contain pyrophosphatase in any estimable quantity." (Author's summary.)

Aird, Robert B., and Mary F. Montgomery, 1936. STUDIES UPON THE SITE OF STIMULATION OF SALIVATION BY INTRAVENTRICULARLY INJECTED Pilocarpine in Dogs. Jour. Pharmacol. exper. Therap., 56 (2): 290-306.

A submaxillary duct fistula was performed on each of three dogs anesthetized with chloralose. Pilocarpine HCl (0.2 mgm./kg. of body wt) was injected intraventricularly, intravenously, or subcutaneously, and the rates of absorption via these routes were determined, graphed, and compared according to the quantity and rate of salivation/unit time.

Salivation occurs earliest and the greatest volume of saliva is collected 5 minutes after the intravenous injection of pilocarpine. Release and maximum recovery of saliva is most delayed after intraventricular drug administration.

The maximal rate of salivation is found to be largest after an intravenous injection and least after intraventricular administration of pilocarpine. Experimental data shows that after parasympathetic denervation of the submaxillary gland, the maximal rate of secretion decreases after an intravenous injection and increases after an intraventricular injection of pilocarpine. However, the data is insufficient to attribute the observed changes to denervation effects.

Graphs comparing the urinary excretion of phenosulphonaphthalein and the secretion rate of submaxillary saliva, indicate a dependency of both processes upon the presence of pilocarpine in the blood.

It is concluded that pilocarpine stimulates salivation only by its presence in the blood stream, irrespective of its route of entry.

Aldrich, Martha, and Philip S. Hench, 1923. II. A DISCUSSION OF SALIVARY UREA AND THE MERCURY COMBINING POWER OF SALIVA. Jour. Amer. med. Assoc., 81 (24): 2001-2008.

Various methods of estimating salivary urea, and their efficacy, are discussed.

Aleksandrov, I. S., 1938. IZMENENIYA SLIŪN-NOOTDELENIIA PRI KHRONICHESKOM OTRAVLENII SVINTSOM [Changes in salivation after chronic lead poisoning]. Fiziol. Zhur. SSSR, 24 (5): 996-1003.

Salivary tests were made every 6 to 7 days in 6 dogs with permanent fistulae of the three salivary glands; salivation was induced through various stimuli (pilocarpine, food, HCl, teasing). After a number of tests of saliva stimulated by these substances, two of the dogs received daily subcutaneous injections of 1 mg./kg. of a 2% lead acetate solution; two other dogs received similar 0.5 mg./kg. doses; and two control dogs received physiological salt solution injections.

A sharp increase in pilocarpine salivation was noted in dogs receiving the 1.0 mg. dose after the 5th to 10th injection; this increase slackened upon continued lead injection. An increase in pilocarpine salivation was noted after the 10th injection in dogs receiving the 0.5 mg. dose.

The natural conditioned salivation dropped sharply in dogs receiving the 1 mg. dose on the 6th day of poisoning, then disappeared completely. The natural reflexes, which had either vanished or were greatly weakened, reappeared after cessation of the 6-day poisoning. The natural conditioned salivation persisted longer in dogs receiving the 0.5 mg. lead dose. No deviation from the normal standard was observed, during the same period, for unconditioned salivation in response to food or HCl.

Aleksandrov, I. S., 1939. VLIYANIE TETRA-GIDRO- β -NAFTILAMINA NA SLIŪNNYE ZHELEZY. SOOB-SHCENIE I. [The influence of tetrahydro- β -naphthylamine on the salivary glands]. Communication I. Biull. eksper. Biol. Med. Moskva, 8 (3-4): 242-244.

The action of tetrahydro- β -naphthylamine (B-T) on the salivary glands was studied in a large number of dogs having parotid and

submaxillary-sublingual fistulae. It had been observed earlier (Aleksandrov, 1937) that this pyrogenic drug elicits profuse secretion from the submaxillary and sublingual glands, and practically none from the parotid.

A subcutaneous injection of 5 mg./kg. of a 0.05% B-T solution in vegetal oil elicited a submaxillary and sublingual secretion according to a curve bearing similarity to the body temperature. In 5 hours after injection, 82.5 cc. of saliva were secreted; in the 1st hour, 19.2; in the 2nd, 31.1; in the 3rd, 19.3; in the 4th, 10.5; and in the 5th, 2.4 cc. The secretion starts immediately after the injection, reaching its maximum on the 70th minute (7.8 cc. in 10 min.). After this, the secretion decreases gradually with a wave-like flow. The secretion from the parotid gland amounted to 2.6 cc. in 5 hours, starting after 42 min. and ceasing after 160 min. from the beginning of injection. The time period of parotid secretion coincided with the highest level of body temperature, during which the dog suffered polypnea, which is believed to have caused the secretion. As the body temperature decreased, the polypnea disappeared and the secretion ceased. The functional condition of the parotid gland remains unaffected during the influence of B-T, as the unconditioned reflex to meat-rusk powder and the response to 0.125 mg./kg. pilocarpine (9.2 cc.) are unchanged.

In other experiments the B-T drug and pilocarpine were administered simultaneously. The parotid secretion rate varied little from the preceding case (11.1 cc.). The mixed secretion was greatly decreased (37.5 cc.) as compared to that following injection of B-T alone (in this animal: 64.5 cc.). This inhibitory effect of pilocarpine during simultaneous administration with B-T was also observed in the body temperature, which was lower than that occurring after injection of B-T alone.

The author suggests that these thermo-regulating changes of the salivary glands are due to the central nervous system.

Aleksandrov, I. S., 1939a. THE EFFECT OF TETRAHYDRO- β -NAPHTHYLAMINE UPON THE SALIVATION CENTRES. II. Bull. Biol. Med. expér. URSS, 8 (3-4): 258-263.

A continuation of the analysis of the action of tetrahydro- β -naphthylamine (B-T) upon salivary secretion from the mixed glands is presented. The effect of various narcotics, especially chloral hydrate, upon the B-T stimulated salivation was studied.

The validity of Jonescu's observations on the absence of direct effect of B-T upon the salivary glands under conditions of acute experimentation were ascertained. A dose of 0.2 gm./kg. weight of chloral hydrate, administered per rectum (the canine narcotic dose being 0.6 gm./kg., according to Hinz, Meyer), markedly lowers the B-T stimulated salivation. The secretion from the mixed glands in a non-narcotized dog amounted to 78.5 cc. during 3 hours from the beginning of injection, and only to 25.1 cc. in a dog narcotized with chloral hydrate. Secretion during the 1st, 2nd, and 3rd hours without narcosis was 12.9, 31.2, and 34.4 cc. respectively; after narcosis these values fell to 4.3, 8.6, and 12.2 cc. A drop of the body temperature occurred during the first 30 minutes

from the start of injection; the temperature began to rise in the second half-hour, reaching 39.2°C. at the end of the third hour. The influence of chloral hydrate upon B-T salivation was still noticeable with one tenth of the full narcotic dose. The salivation curve runs parallel to that of the hyperthermic response indicating that the inhibition of salivation in the narcotized animal is due to a decrease in the excitability of the central nervous system. Hence, tetrahydro- β -naphthylamine affects the central part of the secretory apparatus of the mixed salivary glands.

In order to prove this, special acute experiments were performed on curarized dogs. Wharton's duct was exposed either on one or on both sides, cannulated, and the salivary secretion recorded at 5 minute intervals before and after the B-T injection: the temperature was taken at the same time. During increased B-T salivation the superior cervical ganglion was extirpated, and 20 minutes later the chorda tympani severed on the side of the exposed salivary duct. In other experiments both chordae were severed, one 15 minutes after the other.

The results obtained showed that no quantitative change in salivary secretion occurs after removal of the superior cervical ganglion; after the severance of the chorda tympani the glandular secretion rapidly decreases, dropping to the original level recorded prior to the B-T injection and determined by the effect of the injected curare upon the salivary glands. The body temperature increases after chordal resection, thereby demonstrating the efficiency of the injected B-T. However, the B-T-stimulated increase in body temperature and salivary secretion are less pronounced in acute experiments, when curare is given and artificial respiration applied. These experiments support the above conclusion and show that the impulses originating in the central nervous system reach the mixed glands by way of the chorda tympani.

In further experiments a progressive increase of reflex salivation from the mixed glands was noted; on the 67th day it amounted to 1 cc./min. (stimulated by meat and biscuit powder), and continued rising in the period that followed. On the 66th day, 18.6 cc. of B-T stimulated saliva was collected in 3 hours, the secretion starting immediately after injection; on the 123rd day 52.2 cc. were collected (normal amount 69.8 cc.); the unconditioned secretion on the 122nd day was 1.6 cc. (normal amount 3.6 cc.). At this point the animal was still under observation. These data offer complete support for the conclusions drawn on the basis of acute experimentation.

Experiments on the effect produced by atropine as well as a study of the composition of the saliva further confirm the above conclusions. Injections of B-T fail to elicit salivary secretion in cases of complete atropinization of the salivary glands, as should be expected. Saliva secreted from the mixed glands after B-T injection shows an increased content of solid residue during the first two hours as compared to spontaneous salivation; in the third hour the solid residue content is somewhat diminished. The increase in solid residue occurs from inorganic substances, while the percentage of organic matter is slightly lowered. These data are in accord with the changes in salivary composition of the mixed glands caused by stimulation of the peripheral end of the chorda tympani.

The results of these experiments verify the suggestion advanced in the first paper that B-T affects the central part of the secretory apparatus of the submaxillary and sublingual glands, and that the impulses to the glands travel along the parasympathetic nerve fibers.

A conditioned reflex could moreover be worked out by repeated B-T injections, which further corroborates the theory of the central origin of B-T stimulated secretion.

*Aleksandrov, I. S., 1953. VLIYANIE ANTIPYRINA NA SLIUNOOTDELENIE I POVYSHENIE TEMPERATURY TELA, VYZVANNOE TETRAGIDRO- β -NAFTILAMINOM [Influence of antipyrine on salivary secretion and body temperature rise, induced by tetrahydro- β -naphthylamine]. Uchenye Zapiski Leningrad. Pedagog. Inst. im. Gertsena, 88: 71-75. Abst.: Sovet. med. refer. Obozrenie, 1954(19): 10.

Study of simultaneous influence of antipyrine and tetrahydro- β -naphthylamine (B-T) on salivary secretion was made in the dog. After simultaneous injection of 40 mg./kg.-weight of antipyrine and of B-T the rise in temperature and increase in salivary secretion is less pronounced than after injection of B-T alone. If the antipyrine dose is reduced to 20 mg./kg., the salivary secretion remains within the limits of B-T and the temperature increase is levelled out. This "dissociation" between the salivary and the temperature effects can be explained by the unequal functional condition of the vegetative centers in the intermediate brain, as a result of antipyrine action.

*Aleksandrov, I. S., 1953a. VLIYANIE MORFINA NA SLIUNOOTDELENIE I POVYSHENIE TEMPERATURY TELA, VYZVANNYE TETRAGIDRO- β -NAPHTILAMINOM [The influence of morphine on salivary secretion and the rise of body temperature, induced by tetrahydro- β -naphthylamine]. Uchenye Zapiski Leningrad. Pedagog. Inst. im. Gertsena, 88: 77-86. Abst.: Sovet. med. refer. Obozrenie, 1954 (19): 110.

The influence of morphine on the tetrahydro- β -naphthylamine (B-T) effect was studied in the dog. After determination of the morphine dose which did not elicit vomiting or salivation, this dose was injected into the animal, followed 5 minutes later by the B-T. After injection of 0.25 mg./kg.-weight of morphine, the B-T drug induced an increase in secretion from the mixed glands and a less pronounced increase in body temperature than in the control animals which received only the B-T. Further reduction of the morphine dose (0.1 to 0.05 mg./kg.-weight) leads to further difference in the salivary and temperature effect of the B-T drug, decreasing salivation and increasing body temperature. The minimal morphine dose which did not change the usual reaction to B-T was 0.025 mg./kg. body weight. The difference in the secretory and temperature effect is the result of different stimulations in the vegetative centers of the intermediate brain.

*Aleksandrov, I. S., 1953b. VLIYANIE KORAZOLA, KOFEINA I KOKAINA NA SLIUNNYE ZHELEZY. PREDVARITEL'NOE SOOBSHCHENIE [The influence of corazol, caffeine and cocaine on the salivary glands. Preliminary report]. Uchenye Zapiski Leningrad. Pedagog. Inst. im. Gertsena, 88: 87-97. Abst.: Sovet. med. refer. Obozrenie, 1954 (19): 110.

The influence of corazol, caffeine and cocaine on the salivary glands was studied in the dog. Injection of these drugs elicited a salivary secretion analogous to that of tetrahydro- β -naphthylamine or of picrotoxin. Other organic or inorganic substances such as ammonium carbonate may be used as a chemical stimulus of the subcortical salivary center.

*Aleksandrova, A. E., 1955. MEKHAZISM DEYSTVIA GORECHI NA PISHCHEVYE REFLEKSY [The mechanism of the action of bitterness on food reflexes]. Fiziol. Zhur. SSSR, 5: 630-634. Abst.: Sovet. med. refer. Obozrenie, Fiziol., 1956 (28): 124.

The influence of bitter taste on the activity of the salivary glands was studied in 2 dogs with parotid fistulae. The food stimulant (rusk powder, moistened with milk) was administered before 6 drops of a bitter substance, tincture of absinthium, on the tongue. Secretory effects depended on the amount of stimulant: a small amount increased salivary secretion, a large amount depressed it. The conditioned reflex in response to a buzzer showed a pronounced increase after bitter taste stimulation; the conditioned reflex in response to light or touch showed little change after such taste stimulation.

Aleksentseva, E. S., and G. V. Fol'bort, 1938. KOLICHESTVENNYE IZMENENIYA AZOTA V SLIUNE OKOLOUSHNOI ZHELEZY PRI DLITEL'NOI SEKRETSII I POSLE NEE [Quantitative changes in the nitrogen of parotid saliva during and after prolonged secretion]. Fiziol. Zhur. SSSR, 24 (1-2): 15-23.

Study was made of the changes in albumin content of parotid saliva during prolonged secretion and of albumin restoration after it. The normal standard of salivary albumin content was established by feeding 5 fistulated dogs four 1 gm.-pieces of rusk per minute during 5 to 7 minutes; 5 samples of 5 to 8 cc. each were collected with 5 min. intervals. The nitrogen content was tested in every sample by the micro-Kjedahl method, modified by Bang. After a rest period, uninterrupted salivation was elicited by continuous feeding of the dog until its refusal, lasting 2 to 3.5 hours and yielding 75 to 280 cc. of saliva. Fourteen experiments were made with uniform results.

In the establishment of the normal standard, each subsequent salivary sample contains less albumin than the preceding, forming a regular dropping curve. In prolonged, uninterrupted salivation, after a few samples, the albumin curve drops abruptly to zero in the 18th or 19th sample. Qualitative verification tests with Nessler's solution and precipitation by sodium tungstate confirmed the absence of nitrogen in all remaining samples to the end of the experiments.

The restoration of albumin in saliva proceeds as follows: the normal albumin content appears in the sample of submaxillary saliva on the 5th to the 10th day (average 5th to 7th), the total amount of nitrogen increasing daily; within one day, the increase of nitrogen in the 5 samples collected is gradual.

The processes of restoration are therefore much more stimulated by the losses sustained during prolonged secretion, and more than compensate these losses.

Aleksentseva, E. S., 1939. IZMENENIE KOLICHESTVA OSTATOCHNOGO I BELKOVOGO AZOTA V SLIUNE OKOLOUSHNOI ZHELEZY PRI DLITEL'NOI SEKRETSII [Changes

in the quantity of residual and albumin nitrogen in the saliva of the parotid gland during active secretion]. *Biokhimichnyi Zhur. Kiev.*, 13 (1): 73-85.

The author studied the changes in quantities of residual and protein nitrogen in parotid saliva during prolonged secretion, in long-term experiments conducted in 4 dogs. Salivary stimulation was administered by feeding four 1 gm. portions of rusk/minute until refusal (2.5 to 3.5 hours). The saliva was collected every 5 minutes (from 75 to 280 cc.). The nitrogen content was determined by the micro-Kjedahl method. The residual and protein nitrogens were separated by precipitating the proteins with 10% trichloroacetic acid. The residual nitrogen was determined in the filtrate, and the protein nitrogen in the precipitate. The residual nitrogen content in parotid saliva was found to vary normally from 14 to 16 mg.%. The residual nitrogen disappears from the saliva earlier than the protein in prolonged secretion. Restoration of the salivary residual nitrogen to a normal level after prolonged secretion occurs on the 3rd or 4th day, whereas the protein nitrogen in the saliva is restored on the 5th or 6th day after experimentation. The changes studied in saliva during prolonged secretion apparently occur at the expense of the residual nitrogen.

Aleksentseva, E. S., 1940. *IZMENENIE KOLICHESTVA MOLOCHNOI KISLOTY V SLIUNE OKOLOUSHNOI ZHELEZY PRI DLITEL'NOI SEKRETSII I POSLE NEE* [Changes in the content of lactic acid in the saliva of the parotid gland during and after prolonged secretion.] *Fiziol. Zhur. SSSR*, 29 (3): 211-214.

Nine experiments were made on 4 dogs provided with a chronic fistula of the parotid gland. The normal standard of lactic acid content was determined (Friedemann method) in portions of saliva taken 5 times during the day of experimentation, each sample, varying from 6 to 11 cc., being collected during 5 to 7 minutes. Prolonged salivation was elicited through continuous feeding of four 1 g.-pieces of rusk per minute until refusal (after 1.5 to 2.5 hours); 150 to 290 cc. of saliva were thus obtained. Portions of saliva were again examined during 4 to 5 days after experimentation.

The results showed that parotid saliva always contains lactic acid in the amount of 3 to 8 mg. per 100 cc. [average 4.5 to 7.5 mg.%]. The amount of lactic acid during prolonged secretion increases from one portion to the next and reaches 20 to 40 mg./100 cc. On the first day after a prolonged secretion, all the portions of saliva contain less lactic acid than the normal standard amount. The return to normal usually takes place on the 3rd day.

Allaria, G. B., 1917. *UNE MÉTHODE POUR RECUEILLIR LA SALIVE DES NOURRISSONS* [A method of collecting the saliva of nurslings]. *Nourrisson*, 5 (1): 13-16.

An apparatus for obtaining the saliva of nurslings is described in full. The apparatus is composed of a thick glass test tube, 18 cm. in length and 2 cm. in diameter. It is rubber-stoppered, with two tubes leaving the stopper at right angles in opposite directions: one tube is connected to a vacuum pump (water); the other, to

a 20 cm. tube terminating in a small porcelain nipple. The water flow must be adjusted carefully because too great a suction will cause the nipple to adhere to the mucous membrane (particularly to the tongue), preventing collection of the saliva and causing great discomfort of the infant.

Allen, Kenneth D. A., and L. Dickey, 1937. *THE SALIVA CELL COUNTS IN MYELOGENOUS LEUKEMIA*. *Amer. Jour. Roentgenol.*, 38 (1): 57-71.

The present study, including observations of ten cases of myelogenous leukemia, indicates that the leukocyte count of the saliva is of value in the efficient management of this disease. Confirming the work of Isaacs [cf. Isaacs, 1927m], a fairly constant inverse relationship was observed between the cells in blood and those in saliva--that is, a small number of leukocytes in saliva is indicative of a large number in the blood.

A lack of increase in salivary leukocytes ten or more minutes after irradiation (roentgen-ray) treatment is a sign of exhaustion of the hematopoietic myeloblasts of the marrow and indicates a poor prognosis. It might further be indicative of the onset of the myeloblastic stage of leukocytes in the blood and of dyscrasia. An increase of the salivary leukocyte count following irradiation suggests a healthier condition of the marrow cells and good prognosis.

Allington, Herman V., 1950. *DRYNESS OF THE MOUTH*. *Arch. Dermatol. and Syph.*, 62 (6): 829-850, discussion, 848-850.

A detailed review is presented which considers the etiological and related factors concerned in xerostomia, aptyalism, or "dry mouth", and which contains an extensive discussion of the experimental and clinical findings pertinent to the condition. A review of the normal physiology, innervation, and autonomic control of the salivary glands is also included.

Case histories of five female patients are presented, characterized as being representative of Sjögren's syndrome manifestations (especially xerostomia). There was no salivary gland or nervous malfunction in any of the cases.

Alonso Burón, F., 1942. *LA DIFERENCIACIÓN DE LAS SUSTANCIAS ESPECÍFICAS DE LOS GRUPOS SANGÜÍNEOS EN LA SALIVA* [The differentiation of the blood-group-specific substances in the saliva]. *An. espan. de Odontostomatol.*, 1 (3): 221-231. In Spanish, with French, Italian, English, and German summaries (p. 229-231).

Antigens of the blood groups O, A, and B may be demonstrated in the human saliva. When saliva (in dilutions up to 1:1000) is added to a specific antiserum, agglutination of erythrocytes is inhibited if saliva and erythrocytes are of the same group. This phenomenon is observed only in the so-called secretory type of saliva, as opposed to the non-secretory type (cf. Schiff and Sasaki, 1932).

Alpern, D., 1925. *DIE ROLLE EINIGER ELEKTROLYTE IM INNERVATIONS-MECHANISMUS DES SEKRETIONS PROZESSES. I. DIE WIRKUNG VEGETATIVER GIFTE AUF DIE TÄTIGKEIT UND DEN ELEKTROLITGEGHALT DES SPEICHEL DER GLANDULA SUBMAXILLARIS* [The role of certain electrolytes in the innervation mechanism of the secretory processes. I. The effect of vegetative poisons on the activity and the

electrolyte content of the saliva of the submaxillary gland]. Pflüger's Arch. ges. Physiol., 209 (5-6): 723-737.

Salivary samples were collected from fistulated dogs. The calcium-potassium content of the saliva was usually constant; but even when the content changed the ratio of the two elements was almost the same. This coefficient defined the character of the secretory process of the gland. Under the impact of pilocarpine, but especially following injection of physostigmine and ingestion of powdered bread, salivary secretion increased; the coefficient of the electrolytes were similar. After injection of supra-renal, the salivary calcium content increased while the potassium content decreased. The adrenalin saliva was considered to be a mixed secretory substance as it was produced by both sympathetic as well as parasympathetic stimulation.

Calcium sensitized the sympathicotrophic effect of supra-renal but potassium seemed to antagonize this effect. The sympathetic nerve, when stimulated, seemed to alter the quantitative composition of the saliva, and to be the trophic nerve of the salivary gland.

Alpern, D. E., 1925a. ROL' NEKOTORYKH ELEKTROLITOV V INNERVATSIONNOM MEKHAZME SEKRETORNOGO PROTSESSA. SOOBSHCHENIE I. DEISTVIE VEGETATIVNYKH IADOV NA RABOTA I ELEKTROLITNYI SOSTAV SLIUNY IZ PODCHELIUSTNOI SLIUNNOI ZHELEZY [The role of some electrolytes in the nervous mechanism of the secretory process. Communication I. The action of vegetative poisons on glandular function and electrolytic composition of submaxillary saliva]. Mediko-biol. Zhur., Moskva, 1-2: 91-105.

Extensive study was made in 7 fistulated dogs of the sialogogic effects on the submaxillary gland of feeding with rusk powder or of injections of either pilocarpine, epinephrine (Supra-renal Hoechst), or physostigmine with regard to salivary calcium (Ca) and potassium (K) in sympathetic and parasympathetic secretion. Results show that pilocarpine saliva, stimulated by a 0.25 mg./kg. subcutaneous injection, to be similar in watery consistency to chordal saliva; salivation began 8 to 10 minutes after the injection and totaled 72-80 cc. in 75 minutes; the Ca/K value was slightly higher than rusk-stimulated saliva, pilocarpine saliva being somewhat reduced in its organic matter and potassium content. Repeated intravenous injections at 5-minute intervals of CaCl_2 or of KCl solutions showed no effect on pilocarpine-stimulated salivation. Physostigmine elicited submaxillary saliva similar in its Ca/K ratio to that of rusk-stimulated saliva and lesser in quantity than pilocarpine saliva. Epinephrine elicited a 15-minute secretion of thick, opalescent saliva totaling 3 to 8 cc., having a markedly increased Ca/K ratio primarily due to an increase in salivary Ca. Injection of pilocarpine prior to that of epinephrine stimulated a somewhat increased flow of saliva having a less marked increase in its Ca/K value; injection of CaCl_2 prior to epinephrine depressed salivation and increased the Ca/K ratio, while similar injection of KCl increased both salivation and its K content, the Ca/K value approaching that of rusk-stimulated saliva. Prior injection of atropine also suppressed epinephrine salivation. The author concludes that epinephrine salivation is a mixed sympathetic-chordal secretion.

Alpern, D. E., 1925b. ROL' NEKOTORYKH ELEKTROLITOV V INNERVATSIONNOM MEKHAZME SEKRETORNOGO PROTSESSA. SOOBSHCHENIE II. VLIYANIE PEREREZOK I RAZDRAZHENII NERVNYKH PRIVODOV NA DEIATEL'NOST' I ELEKTROLITNYI SOSTAV SLIUNY GL. SUBMAXILLARIS [The role of some electrolytes in the nervous mechanism of the secretory process. Communication II. The influence of resection and stimulation of the nerves on the activity and electrolytic composition of submaxillary saliva.] Mediko-biol. Zhur., Moskva, 4: 93-106.

Extensive study was made of the salivary flow and composition in 9 dogs, 7 of which were fistulated, under various conditions of secretory nerve section and of stimulation. Tests conducted in 2 dogs several days after section of the chorda tympani showed that administration of neither rusk-powder food nor relatively large doses of physostigmine elicited saliva. Injection of epinephrine evoked a few drops of very thick saliva which could not be analyzed. Pilocarpine stimulated prolonged salivation of a turbid nature; analysis of samples collected 10 minutes after initiation of flow showed a normal potassium (K) level and a gradually increasing calcium (Ca) content. Pilocarpine saliva in these animals, collected 6 to 8 days after subsequent excision of the superior cervical ganglion, showed no change in quantity but did show a drop in turbidity and a gradual return to a normal Ca/K value.

Tests conducted in 2 dogs 5 to 6 days after excision of the superior cervical ganglion showed rusk-stimulated saliva to be clear and to have a markedly reduced Ca/K value which was elevated somewhat by injections of CaCl_2 . Epinephrine elicited a similar or slightly reduced rate of salivation to that evoked before the excision; the Ca content was decreased and the K content considerably increased. Similar reduction of the salivary Ca/K ratio is noted in saliva stimulated by rusk, pilocarpine, or physostigmine. Pilocarpine saliva flowed at an increased rate after ganglion excision; the secretion was greatly reduced after administration of Ca. Section of the chorda in these animals resulted in a salivary response only to pilocarpine; the saliva was slightly opalescent and showed no change in Ca/K value. Further tests were conducted in 3 dogs having denervated salivary glands. Faradic stimulation of the chorda elicited saliva having a Ca/K value approximating that of rusk-stimulated saliva. Faradic stimulation of both chorda and sympathetic nerves produced saliva similar to that stimulated by epinephrine, having a slightly increased Ca content and a decreased K content. The effects of the various stimulants on the sympathetic and parasympathetic nervous systems and on the Ca/K balance in the saliva is discussed.

Alpern, D., 1926. DIE ROLLE DER VISCERALEN INNERVATION IM CHEMISMUS DES SEKRETORISCHEN PROZESSES. ZUR PATHOPHYSIOLOGIE DER ZELLPERMEABILITÄT [The role of visceral innervation in the activity of the secretory process. On the pathophysiology of cell permeability]. Pflügers Arch. ges. Physiol. 215 (2): 261-272.

Pilocarpine, and powdered-bread salivary samples were collected from fistulated dogs. The superior cervical ganglion was removed, and later the chorda severed. Results indicated that the chlorine and phosphorus content of the saliva was dependent upon the speed of secretion. The secretion, which increased following removal of the ganglion, slowly returned to normal. Under the

impact of pilocarpine the increase in chlorine and the decrease in phosphorus content were both proportional to the speed of secretion. When both glands were fistulated (second gland serving as control) it became evident that the gland deprived of its natural sympathetic innervation secreted more chlorine, and in most cases also more phosphorus, than the normal gland; this increase showed individual variation. When, after surgical intervention, calcium chloride was injected into the vein of the dog fistulated on both sides, chlorine secretion increased considerably within five minutes; thus the sympathetic tonus was restored to normal. However, no changes were noted in the chlorine content when pilocarpine was used as a stimulating agent following severance of the chorda.

The chemical composition of the saliva is conditioned by the sympathetic nerve. These speculations are based on the determination of sodium, calcium, nitrogen and anion balance in the secretion, and in the salivary gland proper.

Alpern, D., and L. Lindenbaum, 1926a. DAS STICKSTOFFGLEICHGEWICHT IM SEKRET BEI EINIGEN NORMALEN UND PATHOLOGISCHEN VERHÄLTNISSEN DER DRÜSENINNERVATION [Nitrogen equilibrium in secretion in certain normal and pathological conditions of the gland innervation]. *Biochem. Zeitschr.*, 176 (1-3): 62-72.

The submaxillary glands of dogs were fistulated and the superior cervical ganglion removed on the same side. When both glands were fistulated (one served as a control to the other innervated gland) the ganglion was removed on one side. In some dogs the chorda was also severed later. Pilocarpine and pulverized bread were used to stimulate salivary secretion. Results indicated that the sympathetic nerve affected the chemism of the residual nitrogen secretion of the gland. The nitrogen exercised its function through the regulation of the permeability of the tissues conditioned by the physical-chemistry of the cell membranes. When, considering the functional effect of Ca on the sympathetic tonus, CaCl_2 was injected into the desympathetized gland, an increase in residual nitrogen was seen until it returned again to normal. The fact that urea was secreted into the saliva from the gland, following the loss of sympathetic innervation proves that certain changes took place in the cellular permeability.

Ameuille, and Sourdel, 1919m. L'ÉLIMINATION PARALLÈLE DE L'IODURE DE POTASSIUM PAR L'URINE ET PAR LE SALIVE [The simultaneous elimination of potassium iodide in urine and in saliva.] *Compt. rend. Soc. Biol.*, (Paris), 82: 384-385.

In ten normal subjects, intravenous injection of 50 mg. of potassium iodide resulted in a simultaneous elimination of the substance in both the saliva (after approximately 5-7 minutes) and the urine (after about 8-10 minutes) continuing for about four or five hours.

In all cases (except two, not closely controlled) of renal insufficiency studied, both the urinary and salivary elimination of iodide ceased. The authors suggest that, in certain diseases, the affinity of tissues for iodide may be increased and the substance retained in the tissues.

Amrom, S. D., E. I. Bakin, and A. I. Rappa-port, 1935. VLIĖĖNIE PILOKARPINA NA SKOROST' SEKRETSII PODCHELIUSTNOI ZHELEZY PRI RAZDRAZHENII N. CHORDAE TYMPANI [The influence of pilocarpine on the rapidity of submaxillary secretion during stimulation of the chorda tympani]. *Fiziol. Zhur. SSSR*, 18 (5): 810-816.

The influence of pilocarpine on the secretion of the submaxillary gland was studied by Kupalov and Skipin's method (1934). A very accurate relationship was found to exist between the rapidity of secretion of the submaxillary gland and the frequency of rhythmical stimulation of chorda tympani by means of individual breaking faradic strokes. Beginning with slow below-threshold rhythms, the amount of secretion per time-unit increases regularly according to a hyperbola. The greatest interval between the various breaking strokes at which the nerve still elicits secretion is, apparently, the indicator of the summation capacity of the salivary gland. At a very high frequency there is a decrease in secretion. The experiments were carried out on decerebrated dogs after chloralose anesthesia. The lingual nerve was resected as well as the ipsilateral vagus and sympathetic nerves on the neck, and the chorda tympani placed into immersion electrodes. Wharton's duct was cannulated, and the tube, graded to 0.004 cc., connected with a scale. Dupré's double marker registered the time in seconds on a kymograph. The movement of the saliva on the scale was registered by the same marker over the time line by the telegraph-type key. The nerve was stimulated by breaking faradic strokes at a frequency from 1 stroke/9 sec. to 70 strokes/sec., the intervals between the stimulations being equivalent to 9 sec. and 0.014 sec. The power of the current was a little above the threshold at a frequency of about 5 stimulations/sec., and remained constant during the whole experiment. The nerve was stimulated at various frequencies. The secretion rate curves obtained with these frequencies confirmed the results obtained by Kupalov and Skipin (1934).

Pilocarpine hydrochloride (0.12 to 0.6 mg.) was then injected intravenously. In some dogs salivation followed soon after the injection and lasted 1 to 2 min., in others there was no visible effect and the injection had to be repeated; 3 to 5 min. after the end of the pilocarpine salivation, faradic stimulation was resumed at the same frequency as before. The author concentrated on low frequencies and on the comparison of the secretion curves before and after pilocarpine injection.

Fourteen experiments were made with uniform results which are tabulated. A distinct increase in chordal secretion usually followed pilocarpine injections. After subliminal doses even the very low frequencies of faradic stimulation, previously without effect, become effective. Indefinite results were obtained only at very high frequencies where, in a few cases, even a decrease in secretion occurred (which may indicate that the frequency was "pessimal"). The form of the curve giving the relation between the stimulation intervals and the rapidity of secretion per second remains the same as before the pilocarpine injection. Thus, pilocarpine exerts its influence merely on the secretion of the salivary fluid, by increasing the stimulation and summation capacity of the gland; this results in a lower content of organic and inorganic substances.

Anders, John T., 1955. CHLORIDE IN SALIVA. Jour. dent. Res., 34 (5): 668.

A method is presented for measurement of the chloride-ion concentration of saliva, based on the titration of deproteinized saliva against mercuric nitrate, using diphenylcarbazone as an indicator. In 251 subjects, from 3.5 to 15 years of age, the concentration ranged from 6.49 to 37.88 mEq. Cl/l. Of this group 30 caries-free individuals had an average of 12.59 mEq. Cl/l; 80 cases, with extensive active dental caries, had an average of 18.31 mEq. Cl/l. The moderate groups fell in between these values. A high chloride level is apparently associated with high caries incidence. The possible effect of the salivary chloride-ion as an amylase activator is discussed. (From author's abstract)

Anders, J. T., 1956. PHYSIOLOGIC CHLORIDE LEVEL OF THE SALIVA. Jour. Applied Physiol., 8 (6): 659-660.

Determinations of the salivary chloride concentration in samples of resting saliva from 431 children showed a mean of 16.25 mEq/L. in 3 series of tests. Analysis of results showed no correlation between chloride level and sex. Salivary chloride determinations of paraffin-stimulated samples of the saliva of 9 subjects varied markedly from results of tests using the unstimulated resting saliva. No appreciable change in the salivary chloride level of 4 individuals was found in saliva samples collected every 30 minutes for 6 hours after ingestion of 2 gm. of sodium chloride. Replicability of test results in children is analyzed and briefly discussed.

Anders, John T., 1956a. ESTIMATION OF THE CHLORIDE LEVEL OF SALIVA. Jour. dent. Res., 35 (5): 753-759.

A modified technique (Schales, O., and Schales, S. S., 1941. Jour. biol. Chem., 140 (3): 879-884.) is described for determination of the chloride level of saliva. Use of the technique in a study of salivas of 251 children, ranging in approximate age from 3 to 15 years and in dental condition from caries-free to caries-rampant, showed a significant difference in the mean chloride level of the salivas of the two extreme groups. Relationships between the chloride level, salivary amylase activity and dental caries is discussed. A classification of categories of dental caries condition is suggested for a long-range caries prevalence study.

Anders, J. T., 1957. THE CHLORIDE LEVEL OF SALIVA. II. Jour. dent. Res., 36 (2): 230-232.

Three series of tests were made over an 18-month period comprising 741 determinations of the chloride level in the unstimulated salivas of 431 children fasting for 2 or more hours. Results show a mean chloride level of 16.25 ± 4.63 mEq/L. with a range of 6.49 to 4.287 mEq/L. Analyses of findings with regard to degree of caries activity showed an increase in the chloride level to be correlated to a greater tendency for dental decay activity.

Anderson, D. J., 1949. THE HYDROGEN-ION CONCENTRATION OF THE SALIVA. I. FACTORS INFLUENCING CO₂ CONTENT. Jour. dent. Res., 28 (1): 72-76.

Changes of CO₂ content of saliva upon its exposure to air were studied. Large volumes of

stimulated and unstimulated saliva were collected and deposited into a beaker under liquid paraffin. The saliva was immediately transferred to a graduated burette (over mercury), from which measured volumes could be drawn when required. Three saliva samples (3 ml. each) were separated into small beakers and were exposed to air for periods of time ranging from 1 to 6 minutes, and were then covered with liquid paraffin. Measured volumes were stored between columns of mercury in modified Hempel pipettes. A Van Slyke volumetric apparatus was used to estimate the CO₂ content.

A comparison of the CO₂ changes was made between the saliva samples and three sodium bicarbonate solutions, treated in the same way.

Results showed that unstimulated saliva (5 samples) lost CO₂ more rapidly than did the stimulated saliva (5 samples). The mean CO₂ loss in the unstimulated saliva amounted to 0.73 vol. % at 1 min. and 2.60 vol. % at 6 min., while in the stimulated saliva the loss was 0.64 vol. % at 1 min. and 1.60 vol. % at 6 min. Statistical significance is attached only to the one-minute measurements.

The possibility was considered that a higher concentration, or a more active state, of carbonic anhydrase might be present in the unstimulated saliva, than in the stimulated saliva. 20 ml. of unstimulated saliva were mixed with 15 mg. sulfanilamide and transferred to a graduated burette. Mean CO₂ losses, tested by the aforementioned method, were 0.62 vol. % at 1 min. and 2.42 vol. % at 6 min., bearing close resemblance to those obtained without sulfanilamide. No significant statistical differences were found between the two means.

Anderson, D. J., 1949a. THE HYDROGEN-ION CONCENTRATION OF THE SALIVA. II. THE RELATIONSHIP BETWEEN HYDROGEN-ION CONCENTRATION AND RATE OF FLOW OF SALIVA. Jour. dent. Res., 28 (6): 583-588.

Intraoral measurements of the salivary pH of one person were made six times daily for two weeks, in an attempt to ascertain diurnal variations. The method of measurement, using a Stadie microglass electrode, is described.

The effect on salivary hydrogen-ion concentration of substances known to alter the plasma alkali reserve was then studied. The experiments were planned in a three-day rotation. 5 g. doses of NH₄Cl were administered the first day to test the effect of an acidifying agent; 10 g. doses of NaHCO₃, the second day for the effects of an alkalinizing agent; 350 ml. of water alone were administered on the third day as a control. Measurements were taken five times daily.

Results, plotted on a scatter diagram, showed a negative correlation between the hydrogen-ion concentration and the rate of salivary flow. The correlation coefficient was calculated as -0.708 ± 0.1066 . The pH ranged between 6.46 and 7.00.

Scatter diagrams were similarly constructed for the hydrogen-ion concentration plotted against the rate of flow after administration of NaHCO₃ and NH₄Cl. A statistically significant negative correlation was observed. The correlation coefficient was calculated to be -0.494 ± 0.218 for NaHCO₃ and -0.656 ± 0.186 for NH₄Cl. The mean hydrogen-ion concentration, expressed in pH units, was 6.783, falling to 6.728 after NH₄Cl, and rising to 6.848 after NaHCO₃ administration.

Andreyev, L., and L. I. Pugsley, 1933. THE EFFECT OF PARATHYROID HORMONE AND OF IRRADIATED ERGOSTEROL UPON THE CALCIUM CONTENT OF THE PAROTID SALIVA OF THE DOG. Jour. Physiol., (London) 80 (1): 96-100.

Tests of various salivary stimuli on the conditioned reflex of 3 dogs with permanent parotid gland fistulae showed parotid saliva elicited by either meat powder, sodium chloride (5% solution), or hydrochloric acid (0.25% solution) to have a calcium concentration over three times that of the serum. Parotid saliva produced by intravenous injection of pilocarpine hydrochloride (0.3 mg./kg. of body weight) had a lower calcium concentration than that produced by the other stimuli. An increase in serum calcium, produced by administration of either ergosterol or parathyroid hormone was accompanied by a marked increase in the calcium concentration of the stimulated parotid saliva, exceeding that of the serum.

Anichkova-Platonova, E. I., 1897. O MIKROBNOM ZAGRAZNIENII RTA U BOL'NYKH [On microbic contamination of the mouths of patients]. Voenno-med. Zhur., 190 (Sep.): 276-291.

Counts were made of salivary bacteria of 38 patients. The number of bacteria varied from 0.3 to 18 million per cc. saliva. No differential counts are given. The following bacteria were identified: Staphylococcus aureus [Micrococcus pyogenes var. aureus], S. albus [M. pyogenes var. albus], Streptococcus, tubercle bacillus [Mycobacterium tuberculosis], Diplococcus Fränkel [D. pneumoniae], Bacillus subtilis [?], B. fluorescens [?], B. luteus [?], Cladothrix dichotoma [?], Bacillus megaterium, Leptothrix buccalis [Leptotrichia b.], a bacterium similar to that of Podbiel'skii, Micrococcus cereus albus [M. albocereus], M. roseus, M. flavus, Sarcina alba, and S. aurantiaca.

Anishchenko, A., 1933. K VOPROSU O VZAIMOOTNOSHENIIĀKH FLORY POLOSTI RTA I SLIŬNY [On the interrelationship between the flora of the mouth cavity and the saliva]. Sovet. Stomatologiya, 1-2: 49-50.

The canine oral microflora was studied in dogs having excised or ligated salivary glands; the dogs all had healthy mouths and teeth. Smears were made from scrapings from the necks of the teeth, the palate, and the tonsils in animals starved 24 hours; the mouth was then rinsed with 10.0% sterile physiological solution, and the rinsing water collected and seeded on sugar-agar at 45°C. Scrapings from the neck of the teeth, palate, and tonsils under various salivary conditions, were also seeded in sugar-bouillon. Cultures of diplostreptococcus were nearly always found in liquid medium. A varied flora including the same diplostreptococcus appeared on the solid medium culture of the rinsing. All cultures of the scrapings revealed a uniform flora. The author concludes that the increase or decrease of salivary secretion, or the type of saliva (parotid or mixed) play a limited role in the changes of the microbial flora of the mouth. This flora is the same in man as in the dog, therefore one has to be more reserved in conclusions on the influence of electrolytes, salivary reaction, lysozymes, etc. on oral bacterial growth in man.

Anokhin, P. K., D. G. Gol'dberg and N. M. Shamarina, 1930. KROVENAPOLNENIE SLIUNNOI ZHELEZY V POKOE I DEIATEL'NOSTI [The blood supply of the salivary gland at rest and during activity]. Fiziol. Zhur., SSSR, 13 (3): 402-406. Same article published also in German: DIE BLUTVERSORGUNG DER SPEICHELDRÜSE IM ZUSTAND DER RUHE UND BEI GESTEIGERTER FUNKTION. Pflüger's Arch. ges. Physiol., 225 (4): 463-466. 1930.

The average blood supply of the submaxillary gland was studied at rest and during activity by means of an electrical drop-registering apparatus constructed by the author (Anokhin, P. K. and A. P. Anokhina-Ivanova, 1929). Seven experiments were made in dogs under morphine-ether anaesthesia. Through the use of the author's apparatus with the creation of a vacuum in the interspace, the blood from the jugular vein would arrive into conditions of resistance similar to those encountered in the gland itself. By opening the tap of the vessel with the electrolyte a negative pressure was formed in the space into which the blood was flowing; this negative pressure was made equal to the one in the lower part of v. jugularis ext., i.e. about 0.2 to 0.3 mm. Hg. From the jugular vein the blood arrived in a solution of sulfate of magnesium connected with the transmitting system. The rest of the method was as usual: all the veins arriving at v. jugularis, with the exception of the glandular veins, were ligated. V. jugularis was resected at the middle of the neck and connected with the transmitting system according to Karta-shevskii's procedure. In all the experiments the blood pressure was measured at the femoral artery, and the submaxillary gland was weighted after the experiment. Control experiments were made to test the effect of various anaesthetics on the blood flow.

The tabulated results show that the blood supply of the gland is not necessarily proportional to its weight. The average blood supply at rest is 26.3 to 30.2 cc. in 1 min. per 100 g. glandular weight and with a pressure of 100 mm. Hg.; after maximal stimulation of chorda tympani it is 60.0 to 88.0 cc. in 1 min. The use of different narcotics on the same gland has shown that the vascular tonus fluctuates greatly under their influence, the blood supply at rest changing from 13.98 to 41.5 cc. depending on the drug used.

The data obtained by former authors appear exaggerated due to an inadequate technique. Babkin's results come nearest to those obtained by the author.

Anokhin, P. K., and B. I. Lisagor, 1930a. K VOPROSU O ZNACHENII KROVOSNABZHENIIĀ ZHELEZ DLIĀ SEKRETSII SLIŬNY [On the question of the importance of glandular blood supply for salivary secretion]. Fiziol. Zhur. SSSR, 13 (3): 393-400. Same article published also in German: ZUR FRAGE VON DER BEDEUTUNG DER BLUTVERSORGUNG DER DRÜSEN FÜR DIE SPEICHELSEKRETION. Pflüger's Arch. ges. Physiol., 225 (4): 561-566. 1930.

The influence of limited blood supply on salivary secretion was studied in a dog with submaxillary fistula under perfectly natural reflex conditions. The dog's art. carotis communis had been brought to the surface in a skin bridge (Cohn and Levy method, 1920), permitting the clamping of the artery at any moment. The clamping was usually done 2 to 3 min. before feeding, unnoticed by the

animal. The saliva was collected during and after the feeding and examined for organic and inorganic content. The recording of the secretion and blood supply were done by the author's electrical drop register (Anokhin, P. K., and A. P. Anokhina-Ivanova, 1929). The stimuli used were crushed rusk, powdered meat and rusk, and 15 cc. of a 0.5% hydrochloric acid solution.

Five series of experiments, detailed in tables, show that a constriction of the artery invariably leads to a decrease in salivary secretion and to an increase in dry residue, namely in organic matter, while the ash content decreases in the great majority of cases. (These data confirm many facts given by Langley, 1890, and Carlson, 1907.) The longer the delay between the arterial constriction and the feeding, the smaller the increase in dry residue. In a second feeding during the period of constriction, the amount of dry residue is considerably smaller than in the first feeding and approaches a normal amount after 30 to 40 sec. The opening of the artery a few minutes before the feeding leads to an almost normal relation between the organic and inorganic components of the saliva, while in feeding immediately after the opening of the artery this is disrupted. These experiments were repeated under pilocarpine stimulation, resulting in a disrupted rate of salivation which, however, returned to normal after 1 to 1.5 min.

These results lead the author to the assumption that the changes observed in the amounts of normal salivary secretion are intimately related to phenomena of adaptation of the vasomotor reflexes, which make the increase or decrease of secretion possible according to the nature of the food stimulant.

Anon., 1898. THE VALUE OF SALIVA IN DIGESTING FOOD. Jour. Amer. med. Assoc., 30 (16): 924.

An editorial reviewing some literature data on the digestive properties of saliva.

Anon., 1905. THE OCCURRENCE OF PNEUMOCOCCI IN SALIVA OF HEALTHY PERSONS. Jour. Amer. med. Assoc., 45 (3): 197.

A brief review of the occurrence of pneumococci in the salivas of healthy persons.

Anon., 1913. [Queries and minor notes.] ACTION OF SALIVA ON BLUE LITMUS. Jour. Amer. med. Assoc., 61 (7): 507.

The marked acidity of some salivas may be attributed to oral fermentative processes, the production of lactic acid in particular, or occasionally to some blood condition without local fermentation.

Anon., 1922. THE SALIVA OF INFANTS. Jour. Amer. med. Assoc., 79 (15): 1249.

Literature data suggest that the saliva of infants may not be as deficient in amylolytic activity as is generally believed (cf. Mathews, 1920m: 334 and Nicory, 1922m: 387).

Anon., 1922a. DIAGNOSTIC POSSIBILITIES OF SALIVARY ANALYSIS. Jour. Amer. med. Assoc., 79 (21): 1768-1769.

A short editorial on the value of chemical analyses of saliva as a diagnostic procedure.

Anon., 1923. [Queries and minor notes.] SALIVATION IN PARALYSIS AGITANS. Jour. Amer. med. Assoc., 81 (21): 1809.

In reply to a query, it is suggested that the excessive salivation of paralysis agitans, if controllable at all, may be suppressed by alkaloids of the belladonna groups (i.e., scopolamin, duboisine, atropin).

Anon., 1927. [Queries and minor notes.] CORRECTION OF ACID MOUTH. Jour. Amer. med. Assoc., 89 (5): 394.

An "acid condition of the mouth which causes destruction of teeth," may be corrected by cleanliness and general dental care, and the cessation of sweets at the end of meals. There is no apparent definite relation between the reaction of saliva and the ingestion of food, or presence of disease.

Anon., 1929. [Queries and minor notes] GLYCOSIALIA AND GLYCOSIALORRHEA. Jour. Amer. med. Assoc., 93 (14): 1070.

A brief review of literature data on the presence of sugar in saliva and the concomitant excessive salivation is presented.

Anon., 1929a. A BIOCHEMICAL VIEW OF "ACID MOUTH". Jour. Amer. med. Assoc., 92 (11): 899-900.

A short review on mouth acidity and the effect of extraneous substances (i.e. food, etc.) indicates that dentifrices probably do not possess any qualities for correction of this condition.

Anon., 1929b. [Queries and minor notes] ABSENCE OF SALIVA. Jour. Amer. med. Assoc., 93 (13): 1012.

No definite therapy could be recommended for a case of sialoschesis during sleep in a 67 year-old man. Strychnine is suggested but its therapeutic value is doubtful. It is believed the occurrence may be nothing more than the result of unusually deep sleep.

Anon., 1930. [Queries and minor notes] SALIVATION DURING PREGNANCY. Jour. Amer. med. Assoc., 94 (2): 126.

Daily subcutaneous injections of 1 to 2 liters of physiological saline or Locke's solution is advocated for treatment of excessive salivation occurring in a 27-year-old primipara. Sodium bromide, 7 g. given daily in divided doses, is considered "practically the only drug that may be helpful."

Anon., 1932. [Queries and minor notes] SALIVATION DURING PREGNANCY. Jour. Amer. med. Assoc., 99 (5): 412.

In response to a query on the advisable treatment for constant and excessive salivation occurring in a 26-year-old woman in the third month of gestation, attention is called to the rarity of this condition and the subsequent lack of suitable treatment. A possible cause may be a reflex neurosis, incident to pregnancy, in which case psychotherapy is suggested. In the majority of cases, however, the condition is a form of toxemia resembling hyperemesis gravidarum. Some women lose a liter or more of fluid every 24 hours and the importance of replenishing this water is stressed. The subcutaneous administration of at least 2 liters daily of physiological salt solution or Locke's solution is suggested. Other recommended means

are a diet limited to milk, administration of 7 to 8 gm. sodium bromide daily, and atropine injections.

An examination of the salivary fluid is essential to ascertain that the fluid escaping from the mouth is actually saliva and not gastric juice.

Anon., 1932a. DRY MOUTH AFTER ALCOHOL. Jour. Amer. med. Assoc., 99 (16): 1375.

The sensation of dry mouth is considered to be the result of an irritation of the oral mucosa caused by beverages with high alcoholic content. The thirst usually experienced within a few hours after ingestion of such beverages is attributed to the diuretic effect of the alcohol and to the loss of water through the skin, the sweat glands, and possibly also through the lungs. A possible factor in the dryness and thirst may be the inhibition of salivary secretion and of mucin production by alcohol in the blood.

Anon., 1932b. [Queries and minor notes] LACK OF SALIVARY SECRETION. Jour. Amer. med. Assoc., 99 (26): 2204.

In answer to a request for advice as to treatment for a 60-year-old woman, almost completely devoid of saliva, it is suggested that optimal oral hygiene be enforced, that a complete denture be provided ("mechanical excitation of a dental plate at the openings of the salivary glands often exerts a favorable influence"), that gum be chewed, or -- in the event that there is no stomatitis -- that reflex stimulation be induced by the application of irritants as a mouth wash (i.e. spirit of camphor, tincture of capsi-cum, or the two combined, from 1/2 to 1 teaspoonful in a glass of hot water). If the oral cavity is irritated, it is suggested that the tongue be dipped in oil of sweet almond for 5 minutes immediately before meals; a glycerin mouth wash is suggested for temporary relief.

Anon., 1933. [Queries and minor notes] SALIVATION. Jour. Amer. med. Assoc., 100 (12): 992.

A suggestion was requested for treatment of a 67-year-old cigarette smoking man, having excessive salivation (particularly in the after-noons and evenings) and who derived no beneficial effect from Bellafoline (a chemical preparation containing belladonna).

This excessive salivation may be due to a local oral infection, to a poorly fitted plate, to smoking, or to some gastro-intestinal condition. It is suggested that smoking be restricted, and any irritative factors be removed. Bellafoline had not been accepted by the Council on Pharmacy and Chemistry for inclusion in New and Nonofficial Remedies.

Anon., 1935. THE SALIVA AND IMMUNITY TO DIPHTHERIA. Jour. Amer. med. Assoc., 104 (15): 1351.

A note attributes marked anti-diphtheric properties to saliva which is considered capable of destroying diphtheria bacilli [*Corynebacterium diphtheriae*], or of transforming them into harmless, pseudo-diphtheria bacilli [*C. pseudo-diphtheriae*].

Anon., 1935a. [Queries and minor notes] PTYALISM DURING PREGNANCY. Jour. Amer. med. Assoc., 104 (23): 2116.

Ptyalism, noted during a pregnancy, ceased after labor to reappear 3 years later during a cold and to persist (1 year) to the present. The condition, not considered a "true ptyalism" is characterized by the occurrence in the mouth of large amounts of thin, lumpy fluid which disappears on eating breakfast, and reappears only the following morning. Local causes are suggested, but a possible hormonal or vitamin imbalance is not to be excluded.

Anon., 1936. [Queries and minor notes] SIALORRHEA. Jour. Amer. med. Assoc., 107 (23): 1913.

Administration of scopolamine or stramonium, or possibly atropine, is suggested as a means of diminishing the free flow of saliva in a patient suffering from paralysis agitans.

Anon., 1937. SALIVARY IMMUNITY. Jour. Amer. med. Assoc., 108 (14): 1264-1265. April 10, 1937.

A short review of literature on the theories of salivary immunity is presented.

Anon., 1939. BACTERICIDAL ACTION OF SALIVA. Jour. Amer. med. Assoc., 112 (24): 2620.

A note on the work of Dr. A. Lande on the antibacterial properties of saliva (inhibines) and the correlation of their occurrence with the incidence of morbid processes in the oral cavity. The salivas of 5.33% of 152 children having a history of repeated anginas, diphtheria, scarlet fever, or chronic tonsillitis, yielded inhibines, while 38.46% of those children who never had these diseases were positive. No individuals having, or ever having had diphtheria produced inhibines in their saliva.

Anon., 1942. [Queries and minor notes] DROOLING IN A CHILD. Jour. Amer. med. Assoc., 119 (1): 116.

It is recommended that the exact cause of the drooling in a 7-1/2 year old mentally retarded child be determined before therapy is prescribed. If drooling is secondary to hypersecretion, administration of atropine is advocated. Psychic factors are not to be ignored.

Anon., 1942a. [Queries and minor notes] PTYALISM IN INFANT. Jour. Amer. med. Assoc., 119 (14): 1154.

Administration of atropine is recommended as a treatment for ptyalism in a one-year old, tongue-tied boy.

Anon., 1943. THE INACTIVATION BY HUMAN SKIN OF INFLUENZA VIRUS IN THE PRESENCE OF SALIVA. U. S. nav. med. Bull., 41 (3): 692-697.

The infectivity of influenza virus-saliva suspensions for man when introduced onto palmar skin was studied. The presence of saliva failed to affect the inactivating properties of the skin against the virus dried upon its surface. However, virus dried upon glass or rubber sheeting in the presence of saliva retained its virulence for as long as 40 minutes after drying. The authors conclude that saliva alone has no virucidal action on the influenza virus (PR-8 strain).

Anon., 1949. [Queries and minor notes] SALIVATION IN PARKINSONISM. Jour. Amer. med. Assoc., 140 (5): 504.

The administration of atropine or of Vinobel[®], an extract of belladonna, is suggested as treatment for the excessive salivation of Parkinsonism.

Anon., 1949a. [Queries and minor notes] OLIGOSIALIA. Jour. Amer. med. Assoc., 140 (10): 929.

Neostigmine bromide, 7.5 mg. after meals, is suggested as treatment of oligosialia in a 74-year-old woman, occurring apparently as the result of a parotid infection.

Anon., 1949b. [Queries and minor notes] SIALORRHEA. Jour. Amer. med. Assoc., 140 (17): 1374.

Administration of atropine (ap. 0.25 mg. after breakfast and lunch) is advocated as a treatment for persistent sialorrhea in a 70-year-old man. Thorough cleansing of the mouth and ingestion of vitamin B complex concentrate for a period of several weeks are also suggested.

Anon., 1950. SALIVARY TASTE HORMONES. Jour. Amer. med. Assoc., 142 (2): 113.

A short review of literature indicates that human saliva contains numerous specific taste activators in the nature of hormones. (cf. Blakeslee, 1931m, Fox, 1932m, and Cohen, 1949m).

Anrep, G. V., 1921. THE METABOLISM OF THE SALIVARY GLANDS. I. THE RELATION OF THE CHORDA TYMPANI TO THE NITROGEN METABOLISM OF THE SUBMAXILLARY GLAND. Jour. Physiol. (London), 54 (5-6): 319-331.

A study was made of the nitrogen metabolism of the submaxillary gland of dogs. Stimulation of the chorda tympani produced a secretion in which the nitrogen output was greater than the loss by the submaxillary gland. The amount of nitrogen lost by the gland was equivalent to the output of mucin nitrogen in the gland. Non-mucin nitrogen, derived from body fluids, was equal to the excess produced. It is concluded that no formation of mucin or increase of nitrogenous cell substances takes place during chorda stimulation.

Anrep, G. V., 1922. OBSERVATIONS ON AUGMENTED SALIVARY SECRETION. Jour. Physiol. (London), 56 (3-4): 263-268.

The possible cause of the augmented salivary secretion brought about by stimulation of the sympathetic nerve was studied in dogs. It is suggested that a narrowing of the ducts, due either to their own contractility or to the contraction of tissues around the alveoli and the ducts, caused the gland to be emptied of stagnant saliva to thus produce the augmented salivary effect.

Anrep, G. V., and R. K. Cannan, 1922a. THE METABOLISM OF THE SALIVARY GLANDS. II. THE BLOOD SUGAR METABOLISM OF THE SUBMAXILLARY GLAND. Jour. Physiol. (London), 56 (3-4): 248-257.

The blood sugar metabolism of the submaxillary gland of the dog was studied. Results indicated that blood sugar was consumed at a fairly constant rate by the resting submaxillary gland. Atropine failed to influence the consumption of sugar; pilocarpine increased the blood sugar consumption of the resting gland, the increase

being proportional to the rate of salivary secretion.

Anrep, G. V., 1922b. THE METABOLISM OF THE SALIVARY GLANDS. IV. THE METABOLISM OF THE REDUCING SUBSTANCE OF THE SUBMAXILLARY GLAND. Jour. Physiol. (London), 57 (1-2): 7-13.

A method for the determination of a reducing substance (glucosamine) in the submaxillary gland is described. The form in which nitrogen is secreted in saliva was studied and the effect of secretion on the reducing substance formed by the gland was determined.

Anrep, G. V., and H. N. Khan, 1924. THE METABOLISM OF THE SALIVARY GLANDS. V. THE PROCESS OF RECONSTRUCTION OF THE SUBMAXILLARY GLAND. Jour. Physiol. (London), 58 (4-5): 302-309.

A physiological study was made of recovery after exhaustion of the submaxillary gland in the dog. The recovery of the exhausted gland was studied under normal conditions in which recovery was slow, under the influence of atropine which had no effect on the rate of recovery, and after extirpation of the superior cervical ganglion which accelerated recovery of the gland.

Appleton, J. L. T., 1927. THE EFFECT OF RINSING THE MOUTH AND BRUSHING THE TEETH UPON THE NUMBER OF BACTERIA PRESENT IN SUBSEQUENT RINSINGS. Dent. Cosmos, 69 (10): 1026-1034.

Vigorous rinsing of the mouth in 3 individuals was found to cause a slight decrease in the numbers of bacteria plated out from immediate subsequent washings. This effect was found transitory, disappearing within an hour. Tests of the effects of mouth rinsing followed by brushing the teeth with a popular tooth paste showed an initial 45% drop in bacterial count. The count from a second rinse 65 to 70 minutes later showed a return to the bacterial count of the original rinse. A second post-brushing rinse 12 hours later showed a 10-12% increase in bacterial numbers over the first.

Appleton, J. L. T., and Earl Lehmer, 1928. THE EFFECT OF CIGARETTE SMOKING ON THE NUMBER OF BACTERIA REMOVABLE IN MOUTH RINSINGS. Dent. Cosmos, 70 (11): 1111-1121.

In vitro experiments in which air or smoke from one cigarette was bubbled through a saliva - tap water - nutrient agar suspension indicated that aeration reduced the number of bacterial colonies on plating of the suspension (47% of controls). Treatment with the tobacco smoke caused a further 35% drop. In vivo tests in 15 individuals showed the smoking of 1 cigarette to reduce the number of bacteria, obtained by rinsing the mouth, by about 40%. Thirty minutes after smoking the number was 26% below that of controls. One hour after smoking no difference in numbers was noted.

Appleton, J. L. T., 1936. MOUSE PROTECTION TESTS WITH SALIVA. Jour. dent. Res., 15 (5): 337-338.

The protective action of centrifuged saliva from one person against *Serratia marcescens* was studied. The experimental animals (totaling more than 200 mice) were divided into three groups: one group received intraperitoneal injections of 0.5 cc. of centrifuged saliva (only one death

occurred in this group); another group received intraperitoneal injections of 0.5 cc. of 24-hour broth culture of the bacterium, diluted 1:7 with sterile broth; the third group received intraperitoneal injections of 0.5 cc. of 24-hour broth-culture of the bacterium, diluted 1:7 with centrifuged saliva. The animals were observed for 72 hours (deaths, and order of death were noted, and blood cultures taken), after which all survivors were chloroformed and heart-blood cultures made. In mice that had received saliva suspensions, the gross mortality was lower, the death later, and fewer positive heart-blood cultures were obtained, than in mice receiving broth suspensions alone. Corroboratory results were obtained with the salivas of other individuals.

Appleton, J. L. T., 1937a. ÜBER DIE SCHUTZWIRKUNG DES MENSCHLICHEN SPEICHEL [On the protective effect of human saliva]. Zeitschr. Stomatol. 35 (1): 18-24.

Two series of mice received injections of *Serratia marcescens*, one in saliva suspensions and the other in broth suspensions. In comparing the effects in the two series, it was noted that mice injected with saliva suspensions showed: 1) a lower mortality rate, 2) a less positive culture of heart blood in the surviving animals, and 3) a longer life span. The author concludes that there is a defense action in saliva which might be attributed to either an immediate antibacterial action on *S. marcescens*, or to the stimulation of the defense mechanism of the mice, or both.

Appleton, J. L. T., and Anne K. Dietz, 1937b. IN VITRO EFFECT OF SALIVA ON BACTERIA. Jour. dent. Res., 16 (4): 325.

"Inocula of various densities of *Serratia marcescens*, *Escherichia coli*, *Eberthella typhosa*, *Ps. [Pseudomonas] aeruginosa*, seeded into human saliva; incubated at 37°C.; samples of mixtures taken at various times (1.5, 3, 6, 9, to 24 hours). Relative number of bacteria estimated in samples. Saliva from different individuals centrifuged; some sterilized by filtration; some heated at 56°C., 30 minutes; in some bacteria, removed by centrifugation, replaced after filtration or heating. All centrifuged saliva anti-bacterial. Filtered or heated, centrifuged saliva less anti-bacterial. Anti-bacterial effect apparently restored by returning bacteria separated by centrifuging."

Appleton, J. L. T., Henry Klein, and Carroll E. Palmer, 1938. A METHOD FOR MEASURING THE RATE OF ELIMINATION OF BACTERIA FROM THE HUMAN MOUTH. Amer. Jour. Hyg., 28 (2): 213-231.

A method is fully described for determining the elimination of bacteria from the mouth, consisting essentially of the introduction of selected dilutions of test organisms not commonly found in the oral cavity (i.e., *Serratia marcescens*), followed by a single test after a pre-determined time interval for the presence or absence of the organism. A total of 590 separate experiments thus conducted indicate that *S. marcescens* eventually either disappears or is so reduced in numbers that it is not recoverable from the oral cavity by the method employed; that a direct relationship exists between the number of bacteria

introduced and the length of time required to render them non-recoverable; and that the length of time required to reach a defined criterion of elimination varies from individual to individual, the difference being more pronounced the larger the number of introduced bacteria. In an appended study, it is concluded that the presence of saliva (or other mouth fluids) has no bearing upon the results in the above-mentioned test and moreover, that this test is accurate to the extent that a positive culture will result from as few as 4 test bacilli in 0.5 cc. of mouth rinse.

Appleton, J. L. T., 1939. PROTECTIVE EFFECT OF HUMAN SALIVA AGAINST ANTHRAX BACILLI INJECTED INTO THE WHITE MOUSE. Jour. dent. Res., 18 (3): 278.

Four hundred and fifty-six mice were evenly divided into four groups and were inoculated with anthrax bacilli and/or saliva in various combinations. Group I, picked at random, received 0.5 cc. of centrifuged saliva intraperitoneally; Group II, 0.5 cc. centrifuged saliva subcutaneously. After 24 hrs., Groups I, II, and a Group III, were inoculated intraperitoneally with a saline suspension of anthrax bacilli; Group IV, with a suspension of anthrax bacilli in centrifuged saliva.

The mortality rate of the mice inoculated with saliva (Group I, 14%; Group II, 35%, and Group IV, 23%) was much lower than that of mice receiving no saliva (Group III, 61%).

Appleton, J. L. T., 1945. ANTI-INFECTIOUS PROPERTIES OF SALIVA - A REVIEW. Amer. Jour. Orthodont. Oral Surg., 31 (11), Oral Surg.: 659-666.

A review of the literature and discussion of the anti-infectious properties of saliva is presented. Included among these properties are: bacteriostatic, bactericidal, agglutinating power, transformation of virulent bacteria to nonvirulent types, acceleration of blood coagulation, increasing capillary permeability, chemotactic influence on leucocytes, and mouse protective effects.

Armstrong, Phyllis A., and G. N. Jenkins, 1953. STUDIES ON THE ANTI-BACTERIAL SUBSTANCES IN DOG SALIVA. Jour. dent. Res., 32 (5): 733.

"By means of a questionnaire sent to veterinary surgeons and a survey of the literature, we have established that dogs are almost immune to caries. Antibacterial activity to eleven test organisms (among them bacteria which have been described as causing caries) has been demonstrated in every sample of saliva from more than 100 dogs kept under varying conditions. Incubation of the saliva for twenty-four hours increases its activity against three organisms, while incubation for forty-eight hours increases it against seven organisms and destroys the activity against two others. The incubated and nonincubated antibacterial factors have different properties on filtration as regards dialysis, treatment at various temperatures, exposure to ultra-violet light, and absorption on charcoal, but both appear to be protein or protein derivatives. Lysozyme, a polypeptide, occurs in dog saliva in amounts having an average activity of 9 mg. per cent, with a range of from 0.1 to 32.5 mg. per cent of crystalline lysozyme (activity 10^6 units per gram) when assayed turbidimetrically using *Micrococcus lysodeikticus* as test organism. This amount of lysozyme is similar to that present

in human saliva and did not account for the whole antibacterial activity of dog saliva against lysozyme sensitive organisms and could not, in any case, account for activity against those which are lysozyme-insensitive. Evidence therefore exists for a multiplicity of antibacterial agents. Organisms which are potential antibiotic producers have been shown to be present in dog saliva as a result of "double pour plate" and streak technics using the eleven test organisms as before." (Author's abstract)

Armstrong, W. D., and J. W. Knutson, 1943. BACTERIOSTATIC EFFECTS OF QUINONES. Jour. dent. Res., 22 (3): 214.

"The relative efficiency of a number of quinones in preventing acid formation in saliva-glucose mixtures incubated with shaking for 4 hours has been determined to lie in the following descending order: 1,4-naphtho-quinone; 2-methyl-1,4-naphthoquinone; 1,2-naphthoquinone 2,6-dimethoxybenzoquinone; p-benzoquinone; toluquinone; quinhydrone; 1,2-naphthoquinone-4, potassium sulfonate; hydroquinone, 2-hydroxy-1,4-naphthoquinone; toluhydroquinone; sodium-beta-naphthoquinone-4-sulfonate; sodium anthra-quinone-beta-sulfonate and sodium-2-methyl-1,4 naphthohydroquinone disulfate. The first 7 compounds prevent the pH from falling below 5 when in concentrations greater than 2 mg. per cent. The substances exert a bacteriocidal action in addition to their bacteriostatic effect." (Complete paper.)

Armstrong, W. D., and J. W. Knutson, 1943a. EFFECT OF QUINONES ON ACID FORMATION IN SALIVA. Proc. Soc. exper. Biol. Med., 52 (4): 307-310.

The possibility was studied that the bacteria-inhibiting action of synthetic vitamin K in saliva is due to the fact that this vitamin is a quinone and that the antibacterial property of this compound is not related to its vitamin K activity.

Pooled saliva, to which 2% or 10% of its weight of glucose had been added, was incubated with equal molecular concentrations of quinones. Inhibition of acid formation was measured in molecular equivalents in terms of mg. per 100 cc. of vitamin K. When graphed, the data showed that while 1 mg. of vitamin K per 100 cc. saliva decreased the acid formation to a degree below that required for decalcification of tooth structures, for complete inhibition of acid formation a concentration of more than 3 mg./100 cc. was required.

The inhibitory effect of synthetic vitamin K on acid formation in saliva is attributable to its nature as a quinone and is merely incidental to its properties as a vitamin.

A superior antibacterial effect of 1,4-naphthoquinone over 2-methyl-1,4-naphthoquinone was observed; the former exhibited not more than 10% of the vitamin K potency of the latter. 1,2-naphthoquinone and benzoquinone (the vitamin K activities of which are negligible) are also shown to possess, in substantial degree, an ability to interfere with acid formation from glucose by salivary organisms.

A relationship may be supposed to exist between the oxidation-reduction potential of quinones and their activity as bacteriostatic agents.

Three to 5 mg. of vitamin K per 100 cc. saliva-glucose mixture with corresponding amounts of benzoquinone caused a progressive decrease of

Lactobacillus acidophilus counts over a four-hour period, the final count being one-third of the original number while that of the untreated controls increased by approximately 30%.

Preliminary work indicated that several of the naphthoquinones studied inhibited the growth of staphylococci, streptococci, and pneumococci in broth and in Gladstone's medium.

Arnett, John H., Wesley W. Spink, Ruth Boynton, and Suzanne Agnew, 1943. CONCENTRATIONS OF SULFADIAZINE IN HUMAN SALIVA ATTAINED BY CHEWING PARAFFIN CONTAINING SULFADIAZINE. Proc. Soc. exper. Biol. Med., 52 (1): 54-56.

Saliva samples were collected from 20 subjects, one, two, and three hours after each had received 0.325 g. of sulfadiazine by chewing 1.5 g. paraffin blocks or in gelatin capsules. High concentrations of free sulfathiazine were present in the saliva. This procedure is suggested for therapeutic use in acute hemolytic streptococcal infections of the oral cavity.

Arnim, S. S., and H. C. Benedict, 1930. A NEW METHOD FOR DETERMINING THE COLLOID CONTENT OF SALIVA BY ELECTROPHORESIS. Jour. dent. Res., 10 (3): 379-381.

The authors modified the electrophoretic method of Badollet and Payne, applying it to the study of animal fluids.

"A Leitz, slit ultramicroscope and a Northrop-Kunitz cell were used. Five cc. of saliva were diluted to 100 cc. with distilled water in a volumetric flask. After centrifuging, 10 cc. of this solution were titrated with night blue, which was freshly prepared and used in a strength of 0.2 mg. per cc. (0.02 percent). The end point of the titration is reached when the particles no longer migrate in an electrical field. The movement is observed with the aid of an ultramicroscope. A total of 90 volts was used. It was not necessary to determine the potential gradient.

"A large amount of dye would mean either a correspondingly large amount of colloid, principally mucin, or an exceptionally high charge on the colloid. As the charge depends mainly on the H-ion concentration of the solution, this factor was determined in each trial. The H-ion concentration of the solutions have been quite constant at 6.3, measured by the quinhydrone electrode. Therefore, the amount of colloid present is proportional to the amount of dye used to neutralize it. This was verified by the analysis for protein, using the micro-Kjeldahl test for nitrogen. It was found that about 1 mg. of the dye neutralized 2 mg. of the colloid.

"The isoelectric point of the colloid in saliva was pH 3.4 to 3.7. The colloid content of resting saliva from one subject, where the content in general was high, was about twice that of stimulated saliva. Paraffin was used to stimulate the flow. The colloid content of one of the other subjects was much lower and much more constant. About fifty determinations were made. This small number naturally allows no definite conclusions."

Arnold, Francis A., Jr., and F. J. McClure, 1941. A STUDY OF THE RELATIONSHIP OF ORAL *LACTOBACILLUS ACIDOPHILUS* AND SALIVA CHEMISTRY TO DENTAL CARIES. Publ. Health Rep., 56 (30): 1495-1514.

Clinical examinations were made one year apart and salivary samples were collected at 2 and 3 month intervals from 127 school children (average age - 12.9) to determine the relationship of Lactobacillus acidophilus count and salivary properties to dental caries. L. acidophilus count data revealed that there is a definite correlation between the number of these organisms present in saliva and the degree of caries, thus confirming previous data.

Chemical determinations of the following salivary constituents and properties were made: total solids, ash, loss of ignition (organic matter), total nitrogen (N), ammonia nitrogen, corrected total nitrogen (total N minus ammonia N), organic matter nitrogen (% of corrected N in organic matter), % of total N in total solids, O₂ consumed from potassium permanganate (KMnO₄), O₂ consumed from KMnO₄/mg. of total organic matter, and the pH of the isoelectric zone (pH at which the maximum precipitation of salivary mucin occurs); none of the salivary properties were found to have any significant correlation with the presence or extent of dental caries or with the L. acidophilus count. However, there was a tendency for the inactive-carries group to have slightly more salivary ash, and for the caries-active group to have a slightly lower percentage of total solid and organic matter nitrogen.

The pH of coagulation or of the isoelectric zone was found to vary (from pH 2.0 to pH 3.2) between different individuals, and with the buffer solution used.

Arnold, Francis A., Jr., H. Trendley Dean, and Elias Elvove, 1942. DOMESTIC WATER AND DENTAL CARIES. IV. EFFECT OF INCREASING FLUORIDE CONTENT OF A COMMON WATER SUPPLY ON THE LACTO-BACILLUS ACIDOPHILUS COUNTS OF SALIVA. Publ. Health. Rep., 57 (21): 773-780. Also in: Jour. dent. Res., 21 (3): 304.

A study was made of the Lactobacillus acidophilus count of 109 school children, ranging in ages from 9-17, who had been drinking fluorinated water (0.7 p.p.m. of F) for two years after having used fluoride-free water (0.1 p.p.m. of F). Eight salivary samples secured over a period of one year revealed that the L. acidophilus count was not significantly changed by the consumption of fluorinated water.

Arshavskii, I. A., and A. P. Kriutchkova, 1938. FIZIOLOGICHESKAYA KHAARAKTERISTIKA I MEKHANIZMY REGULIATSII SLIUNNYKH ZHELEZ V ONTOGENESE [Physiological characteristics and the mechanism of regulation of the salivary glands in ontogeny]. Fiziol. Zhur. SSSR, 25 (3): 208-216.

Studies were made of the chordal and sympathetic influence on submaxillary salivary secretion in 50 puppies, 1 day to 4 months of age. The submaxillary gland was cannulated under anesthesia, the chorda tympani or (in the youngest animals), the lingual nerve, at the branching of the chord, were exposed and ligated as well as the sympathetic nerve at the point of its branching from the vagus. In the youngest animals the vagus nerve had to be cut at the level of ganglion nodosum. The nerves were stimulated either through induction current (interruptor Bernstein, first coiling, frequency 30/sec.) or through interrupted galvanic current, with alternation of charge to the nerve.

Stimulation of the chorda produced salivary secretion in a dog from the first day of its life. From the first day to the 30th or 40th the saliva is remarkably uniform as to the percentage of organic matter (average 0.8%) and to ash (average 0.4%); neither the stimulation nor the resection of the sympathetic nerve produced any qualitative changes in the chordal saliva which remained perfectly clear. Thus the regulating function of the sympathetic nerve (which is typical for adults) does not exist in puppies up to the 30th or 40th day of age.

The beginning of sympathetic function is seen after the 30th to the 50th day in the appearance of cloudiness in the first portion of chordal saliva secreted. Resection of the sympathetic nerve causes a decrease in organic matter after the first portion of chordal saliva. The start of sympathetic functioning coincides with the severance of the puppy from the mother's milk and transition to ordinary food, as seen in puppies severed at the age of 20 to 25 days (sympathetic saliva appears 2 days after the severance).

The sympathetic nerve, therefore, appears as a regulator of the gland's functions or as a nerve with adaptable trophic action, which establishes its influence much later in the course of ontogeny than the chorda.

Arshavskii, I. A., 1940. POSLEDOVATEL'NOST' VOZNIKNOVENIIA V SLIUNNOI ZHELEZE VAZOMOTORNOI I "ADAPTATSIONNO-TROFICHESKOI" FUNKTSII SIMPATIKUSA V ONTOGENESE [The sequence of appearance in the salivary gland of the vasomotor and the trophic-adaptive function of the sympathetic nerve in the course of ontogeny]. Fiziol. Zhur. SSSR, 29 (1-2): 33-36.

The vasomotor and trophic functions of the sympathetic nerve were studied under severe experimentation (ether or morphine-ether anesthesia) in 14 dogs, 3 adults and 11 puppies from the age of 6 days up, with a view to establish the chronological order of their appearance in ontogeny. The outflow of venous blood from the salivary glands was used to determine the vasomotor influence of the sympathetic nerve. To limit the venous outflow, a paraffined cannula was placed into v. jugularis ext. at the level of its formation from v. maxillaris ext. and v. maxillaris int. V. facialis was ligated at the level of its entry into v. maxillaris ext., in order to restrict the venous outflow mainly through the veins of the salivary glands. The ligated and resected n. vagosympatheticus was placed into immersion electrodes. The vagus nerve was cut at the level of ganglion nodosum to avoid its reflexes. Stimulation was done through induction current (frequency 30 to 40/sec.). In some experiments the dependence of the venous outflow on the stimulation of chorda tympani was studied. The venous outflow and its dependence on nervous stimulation was calculated with a secundometer by the number of blood-drops per minute.

Experiments in all the dogs confirmed earlier findings concerning the marked vasoconstricting effect of sympathetic stimulation in salivary glands. In adult dogs, intervals between drops in the normal venous outflow are from 0.5 to 1.0 sec.; under sympathetic stimulation they increase to 3 or 4 sec. In puppies 1.5 months old, the normal intervals are from 2 to 4 sec.; under sympathetic stimulation they increase 10 or even 20 sec. Under chordal stimulation the venous

outflow becomes a continuous stream whose color changes to bright red; in puppies the intervals between blood-drops can decrease to 1 sec.

Earlier findings have established that sympathetic innervation of the skeletal muscles appears in the puppy between the 14th and 20th day of age (Arshavskii, I. A., and V. D. Rosanova, 1938; Rosanova, V. D., 1938; Arshavskii, I. A., and I. V. Malkiman, 1938) and that the fibers regulating the metabolism of the salivary gland become functional at the age of 1.5 months (Arshavskii, I. A., and A. P. Kriutchkova, 1938; Kriutchkova, A. P., 1939 and 1940). In the present work evidence was obtained that the sympathetic fibers regulating the lumen of the blood-vessels in the salivary gland begin to function almost from the first days of the puppy's life. It follows from these data that the sympathetic system does not begin its action as a physiological entity, but rather in a sequence of separate functions which appear at different stages of ontogeny; the vasoconstrictor function precedes the establishment of the "trophic" function (after Heidenhain, 1878), as manifested in the regulation of the qualitative aspect of salivary secretion.

These data demonstrate the independence of the vasoconstrictor action of the sympathetic nerve and that of its function regulating the metabolism of the salivary glands (as first suggested by Heidenhain).

Arshavskii, I. A., E. V. Morachevskaya, S. M. Shtamler, 1946. LIZOZIM SLIŬNY V ONTOGENEZE [The lysozyme of saliva in ontogeny]. Biull. eksper. Biol. med. Moskva, 21 (4): 69-71.

Determinations were made of the presence of lysozyme in the saliva of 52 dogs from the first days of life to adult age. Tests were made of chordal saliva, using a 24-hour culture of *Micrococcus lysodeikticus* washed in 0.5% NaCl as an indicator. Salivary samples at various dilutions in 0.5% NaCl were added to one cc. of the bacterial culture and incubated at 37°C for 3 hours. Salivary samples collected from dogs, aged 2-2-1/2 months to adulthood, produced complete lysis at a dilution of 1:100; some samples effected partial lysis even at 1:1000 dilutions. The capacity of producing lysozyme at 2-2-1/2 months is correlated to the start of the regulating function of the sympathetic nerve function in the dog. Lysozyme was also found in chordal saliva of 2 to 3-day old puppies in somewhat smaller proportion than in adult dogs; lysozyme, absent in the saliva of newly-born puppies, increases in amount from the 10th to 15th day of life. The salivary lysozyme of young puppies is assumed to come from the mother's milk which was found to have a very high titer, complete lysis occasionally occurring at a 1:10,000,000 dilution. Salivary lysozyme disappeared in puppies starved for 24 hours, and in 1 to 2-month old canines fed a cow milk-meat diet.

Arthus, Maurice, and Calixte Pagès, 1890. RECHERCHES SUR LA DIGESTION GASTRIQUE DU LAIT [Studies on the gastric digestion of milk]. Compt. rend. Soc. Biol. (Paris), 42, Mém.: 131-176.

The effect of dog and goat saliva on the coagulation of milk and dissolution of the curd was studied.

Asratian, E. (E. Hasratian), 1934. VLIÎÂNIE PISHCHEVOGO BEZUSLOVNOGO REFLEKSA NA SOOTVETSTVUIUSHCHIE USLOVNYE REFLEKSY [The influence of the unconditioned food reflex on the corresponding conditioned reflexes]. Doklady Akad. Nauk SSSR (Compt. rend. Acad. Sci. URSS), 2 (2): 30-33.

Study is reported of the salivary effects in the dog produced by variation in the time interval between stimulations of an unconditioned food reflex and an associated conditioned reflex. Variation of the time interval between 15 and 100 seconds separating feeding standard portions of a rusk-meat-water stimulus and application of a conditioned stimulus showed that reduction in the time interval weakened all conditioned reflexes. Variations of 15 to 200 seconds between feedings of the standard portion and an increased portion of the food stimulus showed the cumulative unconditioned reflex to increase with decrease in the time interval. Results suggest that the unconditioned salivary reflex exerts an inhibitory influence on the conditioned reflexes.

Asratian, E. (E. Hasratian), 1934a. VLIÎÂNIE POSTORONNIKH I USLOVNYKH RAZDRAZHITELEI NA BEZUSLOVNYI PISHCHEVOI REFLEKS [The influence of extraneous and conditioned stimuli upon an unconditioned food reflex]. Doklady Akad. Nauk SSSR, 2 (2): 99-101.

The influence of exterior factors and conditioned stimulation upon unconditioned food reflexes was studied in two dogs. The salivary rate to a determined portion (12 or 35 gm.) of food was established, then the salivary secretion under the influence of different stimuli was measured every 15 seconds, until complete disappearance of the reflex (1.5 to 20 minutes). Application of positive and negative conditioned stimuli or of extraneous stimuli were applied in various combinations before, during, or after feedings. Results show that positive and negative conditioned food stimuli as well as extraneous stimuli exert a considerable influence on the magnitude of the unconditioned salivary reflex. The nature and extent of the changes depend on the manner in which these stimuli are combined with the unconditioned stimulus.

Asratian, E., 1935. VLIÎÂNIE ODNOVREMENNOÏ PEREREZKI OBOIKH SHEĬNYKH SYMPATHICHESKIKH NERVOV NA PISHCHEVYE USLOVNYE REFLEKSY U SOBAKI [The effect of simultaneous bilateral resection of cervical sympathetic nerves on conditioned food reflexes in the dog]. Fiziol. Zhur. SSSR, 18 (5): 739-758.

The significance of sympathetic nerve resection and superior cervical ganglion extirpation to central sympathetic impulses in the head was studied in a dog whose reflexes previously has been thoroughly investigated. Salivary conditioned and unconditioned secretion served as an indicator. The conditioned reflexes were almost absent during the first 15 to 20 days after simultaneous resection of both sympathetic nerves, and greatly weakened for 5 to 6 months. The unconditioned reflex, on the contrary, was considerably increased during the first month, then weakened with the appearance of the conditioned reflex. The positive conditioned reflexes relatively improved only after 6 to 7 months, but remained essentially below the functions of the preoperative period. The conditioned reflex function is further

described in detail. The author concludes that the changes observed are due basically to adaptation-tropic changes in the cerebral hemispheres, caused by the resection of the sympathetic fibers, i.e. the disruption of the central pathways, rather than to the extirpation of the superior cervical ganglia.

Atkins, A. Paul, 1944. PRACTICAL CARIES CONTROL. Jour. Amer. dent. Assoc., 31 (5): 353-357.

The full paper deals with the clinical application of sodium fluoride in the control of caries. Data presented here concern only the bacterial count of the saliva, which was used as a measuring device in evaluating the usefulness of the fluoride as a caries-arresting agent.

Two or more saliva samples were collected at the same time each day over a period of a few days. The samples were cultured and the counts averaged, forming a base line for each individual. Experimental groups of 20 were submitted to the following procedure: Immediately after eating, the teeth were cleaned by the method usually employed by the individual. The mouth was then rinsed several times with a fluoride solution. The remaining solution was poured over the brush and the teeth were rebrushed. At one-week periods, fresh saliva specimens were taken and bacterial counts made.

After a certain time, the bacterial counts showed a reduction average of 87% in Lactobacillus acidophilus, oral cocci and yeast.

The method of preparation of the fluoride solution is given on p. 357.

Auerswald, Heinz, 1938. WELCHE MIKROORGANISMEN WIRKEN AUF DIPHTHERIE-UND PSEUDO-DIPHTHERIEBAZILLEN ANTAGONISTISCH? EIN BEITRAG ZUR FRAGE DER URSACHE DER HEMMUNGSWIRKUNG DES SPEICHEL AUF DIPHTHERIE-BAZILLEN [Which organisms act antagonistically on diphtheria and pseudo-diphtheria bacilli? A contribution to the question of the cause of the inhibitory action of saliva on diphtheria bacilli]. Centralbl. Bakteriol., 142 (1/2): 32-41.

A limited review of the literature on the inhibitory effect of saliva on microorganisms is presented.

A series of experiments were conducted to determine which organisms are antagonistic to diphtheria and pseudo-diphtheria bacilli; the nature of the bacteriostatic action of saliva on diphtheria bacilli was studied.

Agar plates suitable for diphtheria bacillus growth were each inoculated with two drops of a bouillon-saline suspension of diphtheria or pseudo-diphtheria bacilli, plus a drop of suspension containing the organism whose antagonistic ability was to be tested. The plates were incubated for 72 hours at 37°C. and observed for zones of inhibition at 24, 48, and 72 hours intervals. Of the bacterial groups tested (cocci, spore-forming bacteria, typhus-coli group, vibrios, chromogenic bacteria, and atmospheric germs), only the spore-formers (B[acillus] mesentericus I and II and B. subtilis I and II) demonstrated a consistent and definite inhibition area. Sarcina strains caused a slight inhibition.

The normal occurrence in saliva of organisms antagonistic to diphtheria and pseudo-diphtheria

bacilli was studied. The salivas of 7 persons with healthy mouths were cultured. Only 2 strains of staphylococci, 1 polymorphic streptococcus, and 1 yeast were isolated; none of the antagonistic organisms was found. When the salivary organisms were plated against diphtheria- and pseudo-diphtheria bacilli, no inhibition to any degree occurred.

It is concluded, therefore, that the inhibitory effect of saliva against diphtheria and pseudo-diphtheria bacilli is not attributable to microbial antagonism.

Babkin, B. P., 1912. RABOTA SLIŪNNYKH ZHELEZ SOBAKI POSLE UDALENIIĀ VERKHNIĀGO SHEĪNAGO SOCHUV-STVENNAGO UZLA [The activity of the salivary glands in the dog after removal of the superior cervical sympathetic ganglion]. Russkii Vrach, 1912 (39): 1643-1645.

Study was made of parotid and submaxillary salivary composition and flow in the dog before and after excision of the superior cervical ganglion. Salivation was stimulated by meat powder or sugar, or by solutions of 0.25% HCl or 10% NaCl; determinations were made of salivary organic matter, inorganic content and dry residue. While normal salivation was similar before and after excision of the ganglion, high in organic matter if stimulated by the food and low in organic matter if stimulated by the solutions, a general increase was noted in the salivary organic matter and dry residue after the excision. Parotid saliva elicited by HCl had almost twice the organic content of saliva evolved in response to NaCl; the secretion rate was often similar in both cases during an experimental day. Injection of 0.005 mg. of atropine sulfate stopped parotid and submaxillary salivation in response to meat powder. The sympathetic nervous mechanism of salivation is discussed.

Babkin, B. P., 1913. SEKRETORISCHE UND VASOMOTORISCHE ERSCHEINUNGEN IN SPEICHELDRÜSEN [Secretory and vasomotorial phenomena in the salivary glands]. Pflüger's Arch. ges. Physiol., 149 (9-10): 497-520.

The correlation between the effect of various stimuli and the salivary output of the fistulated submaxillary gland of the dog was investigated. Results showed that while salivary output was similar under the various stimulatory conditions, the saliva did show variations in chemical composition. A marked increase in the blood supply of the submaxillary gland was attributed to dilation of the blood vessels of the stimulated gland.

Babkin, B. P., 1913a. DIE ARBEIT DER SPEICHELDRÜSEN BEIM HUNDE NACH ENTFERNUNG DES GANGLION CERVICALE SUPERIOR SYMPATHICI [The function of the salivary glands following removal of the cervical superior ganglion]. Pflüger's Arch. ges. Physiol., 149 (9-10): 521-531.

Fistulated dogs were injected with doses of 0.004-0.01 gm. atropine. Viscous saliva was secreted twenty-five to thirty minutes following ingestion of powdered meat and sodium chloride. When the same experiment was repeated after excision of the cervical superior ganglion of the dog, the ingestion of meat, NaCl, or quinine had no effect on salivary secretion. Composition and quantity of the saliva excreted after each phase of the experiment is analyzed.

Babkin, B. P., 1927. SEKRETORNYE I MOTORNYE IAVLENIYA V SLIUNNYKH I PANKREATICHESKIKH ZHELEZAKH [Secretory and motor phenomena in salivary and pancreatic glands]. Vracheb. Delo, Kharkov, 10 (23-24): 1868-1870.

A brief survey is made concerning the mechanism producing an augmented salivary response to sympathetic stimulation which has been preceded by parasympathetic stimulation.

Babkin, B. P., and P. D. McLarren, 1927a. THE AUGMENTED SALIVARY SECRETION. Amer. Jour. Physiol., 81 (1): 143-153.

The influence of different nerves (chorda tympani and sympathetic) on the salivary secretion rate was studied in the submaxillary gland of the cat and dog in a series of experiments.

"1. An augmented secretory effect from stimulation of the sympathetic nerve after previous stimulation of the same nerve and massage of the submaxillary gland in dog, was demonstrated.

"2. Contraction of the ductus submaxillaris, and its chief divisions, in the dog as well as in the cat, is excluded as causative of the phenomenon of the augmented sympathetic secretion.

"3. The volume-time curves and, derived from them, the rate curves of the salivary secretion show that different processes,--secretory and motor--may occur in the submaxillary gland under stimulation of the chorda tympani and sympathetic nerve.

"4. The chorda tympani nerve, of a dog and a cat, supplies the secretory elements of the submaxillary gland with secretory fibres. The sympathetic nerve in both animals contains secretory and also motor fibres for the contractile elements of the gland.

"5. A view is advanced that there are two phases in the augmented sympathetic (after chorda) secretion,--a mechanical phase, due to the action of motor fibres in the sympathetic nerve and a secretory phase which appears as a result of previous stimulation of the parasympathetic nerve." (Authors' summary.)

Babkin, B. P., and Margaret E. MacKay, 1930. CONCERNING THE MOTOR MECHANISM OF THE SALIVARY GLANDS. Amer. Jour. Physiol., 91 (2): 370-376.

Experiments on cats and dogs showed that the additional increase in the blood flow through the submaxillary blood vessels following histamine administration is insignificant, of short duration (10 sec.), and is quickly replaced by an inhibition of the blood flow which in turn is followed by an increase. The secretion of saliva usually coincides with the period of inhibition of the blood flow. Results are the same with the glandular capsule intact and after its removal.

Babkin, B. P. 1931. THE INNERVATION OF THE SALIVARY GLANDS. Trans. Roy. Soc. Canada (Sect. V, Biol. Sci.), 25: 205-211.

A review of findings is given concerning stimulation of autonomic innervations of the salivary glands with a suggested classification of the parasympathetic and sympathetic effects based upon the amount and composition of saliva. The following classification of effects is given: 1) parasympathetic: secretory, tropic, and vasodilator, and 2) sympathetic: secretory, motor, and vaso-constrictor.

Babkin, B. P., A. Alley, and G. W. Stavsky, 1932. HUMORAL TRANSMISSION OF CHORDA TYMPANI EFFECT. Trans. Roy. Soc. Canada, (Sect. V, Biol. Sci.), 26: 89-107.

Briefly etherized cats were injected with a urethane-chloralose mixture and the submaxillary ducts were cannulated. The chorda tympani and cervical sympathetic nerves were severed to exclude reflex influences.

Chorda stimulation with physostigminization decreases the systemic blood pressure and increases the blood flow through the opposite gland; atropine prevents these changes. These secretory and vascular responses are not attributable to blood pressure changes, reflex impulses, adrenergic effects, or vague excitation. Evidence indicates that under conditions of physostigminization a substance, possibly a hormone, is transmitted to and affects the opposite gland. Physostigmine apparently is necessary for the preservation or enhancement of the released material and its effects.

A review of findings concerning parasympatho- and sympathomimetic substances is given.

Babkin, B. P., G. W. Stavsky, and A. Alley, 1932a. HUMORAL TRANSMISSION OF CHORDA TYMPANI HORMONE. Amer. Jour. Physiol., 101 (1): 2-3.

An investigation was made in the physostigminized cat of a postulated parasympathetic hormone released by a stimulated submaxillary gland. Unilateral stimulation of the chorda in a cat, having cannulated submaxillary ducts and bilaterally severed chorda and sympathetic nerves, caused a drop in blood pressure and an increase both in secretion and in blood flow in the opposite gland. A similar effect was not produced by lowering the blood pressure by means of arterial bleeding. The effect was prevented by ligature of the glandular vein on the stimulated side. The effect of the chorda tympani hormone could likewise be demonstrated in paralytic secretion of the submaxillary gland under analogous conditions.

*Babkin, P. S., and A. B. Zborovskii, 1951. O VLIYANIY KORY GOLOVNOGO MOZGA NA SEKRETSIIU SLIUNNYKH ZHELEZ [On the influence of the cerebral cortex on the secretion of the salivary glands]. Sbornik nauch. Trudov Krasnoarmeisk. Med. Instit., 2: 12-15. Abst: Sovet. med. refer. Obozrenie, 1953 (14): .89-90.

The influence of the cerebral cortex on salivary secretion was studied in fistulated dogs. The cortex was stimulated by caffeine, Bromural or eserine, and salivary secretion by rusk, fed every 15 seconds. The salivary secretion rate increased 31% under the influence of caffeine, with a simultaneous decrease of salivary organic matter from 15 to 42%, and of inorganic matter from 37 to 45%. Bromural increased salivary secretion 34% and decreased organic substances 32 to 49%, and inorganic 45 to 75%. Small doses of eserine increased unconditioned salivary secretion; average doses produced a conditioned salivary reflex to the surroundings by the second day; large doses of eserine were followed by spontaneous salivation. These qualitative and quantitative changes in salivary secretion after cortical stimulation suggest the influence of the cortical centers on the trophic function by way of the unconditioned salivary reflexes.

Bachrach, Eudoxie, 1920m. ETUDES EXPERIMENTALES SUR LA DÉCOMPOSITION DE L'AMIDON EN PRÉSENCE DE SALIVE CALCINÉE [Experimental studies on the decomposition of starch in the presence of calcined saliva]. *Compt. rend. Soc. Biol. (Paris)*, 83 (37): 1583-1584.

Tests were made to examine the starch-hydrolyzing power of aqueous solutions of calcined saliva, calcined urine and NaCl. Since the reaction took place under non-sterile conditions but did not when sterile technique was used, the decomposition of starch is considered to be the result of bacterial action.

Badanes, Bernard B., 1928. CALCIUM OXALATE AS A FOREIGN CONSTITUENT OF SALIVARY CALCULUS. *Dent. Cosmos* 70 (10): 1018-1019.

A study of salivary calculi of normal individuals, especially those who eat vegetables containing oxalic acid, indicates such calculi to contain a high percentage of calcium oxalate crystals. It is suggested that the oxalic acid from vegetables combines with the calcic salts of saliva to precipitate as insoluble calcium oxalate. This substance with mucin and other precipitated salts, plus food debris, adheres to the tooth surface to form tartar.

Badanes, B. B., 1931. NITROGEN METABOLISM WITH REFERENCE TO GLOBULIN IN SALIVA AND DENTAL CARIES. *Dent. Cosmos*, 73 (3): 289-299.

A discussion of nitrogen metabolism and its role in the production of dental caries is presented. The globulin of saliva may be precipitated as a gelatinous film on teeth by a saline solution introduced into the mouth while eating or by a disturbance of the CO₂ balance of saliva. Bacterial decomposition of the film may produce acids and other substances which attack dental enamel.

Baer, Harold, E. A. Kabat, and V. Knaub, 1950. IMMUNOCHEMICAL STUDIES ON BLOOD GROUPS. X. THE PREPARATION OF BLOOD GROUP A AND B SUBSTANCES AND AN INACTIVE SUBSTANCE FROM INDIVIDUAL HORSE STOMACHS AND OF BLOOD GROUP B SUBSTANCE FROM HUMAN SALIVA. *Jour. exper. Med.*, 91 (1): 105-114.

A study was made of the properties of the substances prepared from the saliva of individuals with blood group B. Nitrogen varied from 3.3 to 5.3 percent, reducing sugar from 45 to 68 percent, glucosamine from 19 to 30 percent, fucose from 11 to 17 percent, and acetyl from 7.7 to 13 percent. Isoagglutination was inhibited in the presence of 2 to 25 micrograms of human B substance when tested against anti-horse B serum; 2 to 10 micrograms inhibited isoagglutination when tested against anti-human B serum.

Bagnall, J. Stanley, and E. Gordon Young, 1930. A STUDY OF CERTAIN PHYSICAL AND CHEMICAL PROPERTIES OF SALIVA IN RELATION TO DENTAL CONDITION IN CHILDREN. *Jour. dent. Res.*, 10 (3): 393-394.

The unstimulated salivas of 28 school children were examined for pH, surface tension, viscosity, and mucin content. The surface tension of the salivary samples was slightly lower than that of water and fairly constant. The salivary pH varied between 7 and 8; it was close to neutral in a series of 7 healthy mouths. The mucin content of the saliva was consistently low. No direct relationship was found between the viscosity of saliva and its mucin content.

Bainbridge, F. A., 1900. OBSERVATIONS ON THE LYMPH FLOW FROM THE SUBMAXILLARY GLAND OF THE DOG. *Jour. Physiol. (London)*, 26 (1 & 2): 79-91.

A study was made of the salivary gland lymph flow of chloroform anesthetized dogs under conditions of rest, chorda tympani stimulation, obstruction of Wharton's duct, stimulation of the cervical sympathetic nerve, venous obstructions and lymphagogues, and the action of injected pilocarpin and of atropine. It is suggested that the increased flow of lymph following chorda and cervical sympathetic stimulation and the injection of pilocarpin is due to the activity of the gland cells rather than to variations of blood pressure brought about by arterial dilation. A relationship between the amount of lymph and the amount of saliva secreted was noted.

Balandina, O. A., 1938. MATERIALY O FIZIOLOGICHESKOM ZNACHENII SIMPATICHESKOI NERVENNOI SISTEMY CHELOVEKA. SOOBSHCHENIE 4; O SIMPATICHESKOI INNERVATSII OKOLOUSHNOI ZHELEZY [Monographs on the sympathetic nervous system in man. Communication 4: On the sympathetic innervation of the parotid gland in man]. *Fiziol. Zhur. SSSR*, 25 (1-2): 59-75.

Parotid salivation was studied in 14 subjects before and after cervico-thoracic gangliectomy. Salivary samples were collected from the capped ducts after oral stimulation by means of an acid rinse or chewing sour fruit. Salivary determinations were made of the bilateral secretion rates as well as of the calcium and potassium content. Injections of one cc. of 1:1000 adrenalin or atropine were made in 20 experiments. Results showed the gangliectomy to be followed by a decrease in spontaneous and in reflex salivation from the desympathized gland, lasting 8 to 15 days, before a return to a normal rate of secretion. Injection of the atropine produced a temporary stop in reflex secretion from the desympathized gland; secretion from the intact gland showed partial inhibition for a somewhat shorter period of time. The results suggest that restoration of secretory function in the desympathized gland occurs by means of its parasympathetic innervation, and that sympathetic nerves conduct less effective secretory stimulations to the glands than do the parasympathetic. Injections of adrenalin, which increased spontaneous salivation in 14 of 20 tests, had a less pronounced effect on reflex salivation. Parotid gland desympathization induced a temporary increase in salivary calcium while salivary potassium remained stable or decreased. Injection of adrenalin usually produced the opposite effect, decreasing the calcium content of the saliva and increasing the potassium content.

Balandina, O. A., 1938a. DU RÔLE DE L'INNERVATION SYMPATHIQUE DANS LA SÉCRÉTION DES GLANDES PAROTIDES CHEZ L'HOMME. 2-ÈME COMMUNICATION [On the role of sympathetic innervation in parotid secretion in man. 2d Communication]. *Bull. Biol. Méd. expér. URSS*, 6 (5): 581-585.

One cc. injections of 1:1000 atropine were administered to eleven subjects to investigate the role of parasympathetic fibers in the return of parotid gland salivation to a normal rate of flow after gangliectomy. Three of the subjects had normal salivary gland innervation, 4 subjects had suffered unilateral cervico-thoracic gangliectomy, and 4 subjects bilateral gangliectomy.

Salivation was stimulated by an oral rinse with 5% citric acid for one minute at 5 to 10 minute intervals. Results showed a sharp and regular decrease in bilateral secretion 5 to 7 minutes after atropine injection in the normal subjects; no cessation of reflex salivation was observed. The secretion decrease in subjects with unilateral gangliectomy was much sharper on the operated side, often dropping to zero for a few /5/ minutes; atropine completely stopped parotid secretion in subjects with bilateral gangliectomy for a much longer time. Subcutaneous injections of one cc. of 1:1000 adrenalin increased spontaneous salivation in 14 of 20 cases. The parasympathetic innervation of the salivary gland is considered to compensate, after a period of time, for the decrease in reflex salivation effected by the gangliectomy.

Balandina, O. A., 1938a. LE ROLE DES NERFS SYMPATHIQUES DANS LA SECRETION DES GLANDES PAROTIDES DE L'HOMME [Role of the sympathetic nerves in the secretion of the parotid glands of man]. Bull. Biol. Méd. expér., URSS. 6 (4): 470-472.

A preliminary study was made of the salivary secretion in patients who, for clinical reasons, had been subjected to Jonesco's gangliectomy. The sympathetic cervical trunk of the patients was resected from the inferior pole of the upper cervical to the stellate ganglion. Saliva from both parotid glands was collected simultaneously before and at different times after the operation by means of a Lashley's capsule, applied to the opening of Stensen's duct. Citric acid, lemon, or sour apples were used as a stimulant. In some experiments spontaneous salivary secretion was also registered. The saliva of 14 operated patients was studied, ten of these before and after the operation.

In all the cases, a certain decrease in reflex and spontaneous salivary secretion from the desympathized gland was observed soon after the sympathectomy. As a rule, this decrease was of short duration; in a few cases, however, it was observed after more than a month following the operation.

In patients who had undergone a gangliectomy 9 months to 3 years prior to the author's examination, the secretion of both parotid glands was equal.

This temporary decrease in salivary secretion after desympathization of the parotid gland could be explained by a diminished functional excitability of the glandular cells to stimulating impulses, or by the elimination of sympathetic impulses. The scope of this work does not permit further conclusions.

Ballantyne, R. M., C. T. Clegg, J. J. Rae, and F. H. Lawford, 1951. AMMONIA PRODUCTION IN SALIVA. Jour. dent. Res., 30 (3): 385-387.

The mechanism of ammonia production of saliva was studied. Paraffin-stimulated saliva samples (number not given) were collected about 2 hours after meals. The ammonia content was determined by the Folin-Bell permittit method; color determinations were made by the Lumteron colorimeter. All samples produced ammonia within 24 hours at room temperature. No direct correlation was observed between ammonia production and lactobacillus counts. Samples having a lactobacillus count over 50,000 produced an average of 27.7 mg.;

those less than 1,000, an average of 36.9 mg. per 100 cc. No significant difference was observed in the amounts of ammonia produced by stimulated and unstimulated salivas (average for 48 hours, 16.9 and 19.0 mg./100 cc., respectively).

Several substances inhibited ammonia production. 1 to 10,000 p.p.m. of sodium fluoride were applied; 1,200 p.p.m. partially inhibited ammonia production, 2,500 p.p.m. produced complete inhibition. Glucose (2.5% final volume) inhibited ammonia production.

Maximum ammonia production occurred at pH 8.5.

When saliva was stored for 24 hours at 6°C., at 16°C., at 50°C., or at 70°C., no ammonia was produced. When incubated at 37°C., ammonia production equaled that of control samples (amount not given).

An increase in ammonia production occurred when 3% urea was added to the saliva. A two-fold increase occurred when glucose was added to the saliva-urea mixture. Glucose had no effect upon the urease activity of jack bean meal.

The ammonia-producing mechanism is destroyed by heating at 50 C. for 24 hours, is removable by filtration (Seitz filter or fritted-glass funnel), and its action is reduced by centrifugation, which partially removes the protein, the probable substrate of the ammonia-producing mechanism (bacteria are suggested).

Ballantyne, R. M., J. J. Rae, and F. H. Lawford, 1952. AMMONIA PRODUCTION AND UREASE ACTIVITY IN SALIVA. Jour. dent. Res., 31 (2): 281-283.

Studies on the salivas of 68 students failed to demonstrate any significant relationship between ammonia production and caries activity (based on lactobacillus counts), between salivary urease content and lactobacillus count, nor between salivary urease and ammonia production. The addition of 2.5% glucose to urea-saliva mixtures consistently stimulated the salivary urease activity within 24 hours.

Bang, I., 1911. UNTERSUCHUNGEN ÜBER DIASTASEN I. [Investigation of diastase]. Biochem Zeitschr., 32 (5-6): 417-442.

A series of experiments were carried out to examine the effects of dialysis, alcohol, sodium chloride and phosphate on the composition of ptyalin.

Barbour, H. G., and B. P. Freedman, 1920. EFFECTS OF Pilocarpine UPON SALIVARY FISTULA DOGS BEFORE AND AFTER COLI INJECTION. Proc. Soc. exper. Biol. Med., (Sci. Proc.) 17: 208-209.

The effect of pilocarpine was studied in 2 salivary-fistula dogs before and after injection of coli vaccine. A fairly constant degree of sensitivity to pilocarpine was produced in two healthy dogs by injections of standard doses of pilocarpine hydrochloride (0.5 mgm. per kg.) at 2-3 day intervals for several weeks. Injection into the dog of a standard dose of pilocarpine during the height of a fever produced by injection of 0.5 cc./kg. of a 10^{12} killed coli/cc. vaccine, resulted in a delay onset of salivary secretion, as well as a diminished maximum and total secretion. The saliva thus obtained was of a much thicker consistency than normal saliva.

The authors suggest that these phenomena may be attributable to a thickening of the blood as

described by Barbour and Howard (Proc. Soc. exper. Biol. Med., 17. 1920.), occurring at the height of such fever.

Barbour, H. G., and B. P. Freedman, 1921. EFFECTS OF Pilocarpine upon Salivary Secretion in Normal and Febrile Dogs. Amer. Jour. Physiol., 57 (3): 387-394.

The salivary rate of flow and chemical composition were determined in pilocarpine-stimulated samples of saliva collected from normal and febrile (coli fever) dogs having a permanent fistula of the right submaxillary duct.

In two normal dogs, an increasing sensitivity to pilocarpine injection was observed; the secretion increased with each experiment (made at 2-3 day intervals) until it was at least twice that occurring after the first injection. In two febrile dogs, the salivary response to pilocarpine was diminished at the height of the fever, probably due to a lack of available water.

Limited studies were made of the chemical constituents of the saliva of one dog in both normal and in febrile states. Injection of pilocarpine on three successive days increased the amount of total solids secreted in 130 minutes from 12.6 mg. to 122.2 mg. on the third day, and to 146.1 on the 18th day of the experiment. During the fever, the saliva was greatly diluted and the total solids somewhat decreased (130.6 mg. and 140.4 on the first and second days of fever, respectively). The inorganic salts roughly paralleled the total solids (attaining a total of 81.7 mg. on the 18th day of the experiment), with the exception of the first and second days of fever when they were markedly diminished (52.0 and 59.8 mg., respectively).

Barbour, A. D., 1929. ENZYMIC HYDROLYSIS OF GLYCOGEN. Jour. Biol. Chem., 85 (1): 29-45.

A comparative study was made of the hydrolysis of rabbit-liver glycogen by muscle glycogenase, and by pancreatic and salivary amylases. A trisaccharide was the product of glycogenase hydrolysis of glycogen; glucose and isomaltose (no maltose) resulted from both salivary and pancreatic amylase-hydrolysis. The ratio of glycogen destroyed to the reducing power of glucose formed per unit time was not constant during the salivary amylolytic process, but the amount of sugar produced increased during the reaction. A phenylhydrazine test on the salivary amylolyzed residue resulted in the formation of isomaltose-like osazone crystals, which, when reprecipitated and dried, melted at 157°.

Barcroft, Joseph, 1901. THE GASEOUS METABOLISM OF THE SUBMAXILLARY GLAND. III. THE EFFECT OF CHORDA ACTIVITY ON THE RESPIRATION OF THE GLAND. Jour. Physiol. (London), 27 (1 & 2): 31-47.

A study was made of the metabolism of the submaxillary gland as measured by the respiratory exchange of the gland during stimulation of the chorda tympani. The oxygen consumption of the gland increased 3 or 4 times during the secretion of the chorda saliva, while the carbonic acid given out in saliva by the gland increased correspondingly.

Barcroft, J., 1908. THE MECHANISM OF VASODILATION IN THE CAT'S SUBMAXILLARY GLAND, (PRELIMINARY COMMUNICATION). Jour. Physiol. (London), 36, Proc., Jan. 25, 1908, p. 53.

Vasodilation of vessels of the submaxillary gland is considered accountable to the effects of metabolites. There is a brief discussion of the findings supporting this conclusion. It is suggested that the relationship of adrenalin, ligation of Wharton's duct, and stimulation of the chorda tympani to vasodilation, salivation, and/or submaxillary blood flow can be explained using the "metabolite theory" as a basis.

Barcroft, Joseph, and Franz Muller, 1912. THE RELATION OF BLOOD-FLOW TO METABOLISM IN THE SUBMAXILLARY GLAND. Jour. Physiol. (London), 44 (4): 259-264.

The relation of blood flow to metabolism in the submaxillary gland was studied. In a series of 15 experiments, the normal blood flow of the submaxillary gland of anaesthetized cats ranged from .25 to .45 cc. blood/g. gland tissue/min.; the oxygen intake ranged from .017 to .027 cc./g./min.

In 4 experiments in the cat, carotid injection of 1:500 or 1:1000 dilutions (in Ringer's solution) of yohimbine produced arteriole dilation and a ten-fold increase in blood flow to the submaxillary gland. No measurable change in oxygen consumption by the gland was observed.

When the chorda tympani was stimulated after such treatment, the metabolism increased from .016 cc./g./min. to .11 cc. (nearly 700%) accompanied by an increased secretion of saliva.

Barcroft, J., and H. Piper, 1912a. THE GASEOUS METABOLISM OF THE SUBMAXILLARY GLAND WITH REFERENCE ESPECIALLY TO THE EFFECT OF ADRENALIN AND THE TIME RELATION OF THE STIMULUS TO THE OXIDATION PROCESS. Jour. Physiol. (London), 44 (5/6): 359-373.

"The oxygen used by the submaxillary gland in decerebrate cats is 0.016-0.028 c.c. per gram per minute; this figure does not differ materially from that used by the glands of anaesthetized cats.

"This is much increased by the injection of adrenalin in doses which cause a flow of about 0.25 c.c. of saliva. Presumably therefore appropriate stimulation of the sympathetic causes an increase in the metabolism of the gland. Reasons are given for the belief that the dilatation of the vessels caused by adrenalin is due to metabolic products rather than dilator fibres.

"Oxygen is used up in abnormal quantities for some minutes after the saliva has ceased to flow, indeed the saliva has almost ceased at the time of the maximal oxygen use.

"In the case of chorda tympani stimulation the period of increased oxygen outlasts that of salivary secretion by several minutes: the disparity being greater the less 'fit' the gland. Probably therefore gland, like muscle, is a mechanism in which the oxidation serves to replenish a store of potential energy which is liberated in the act of secretion." (Author's summary.)

Barcroft, Joseph, and T. Kato, 1916. EFFECTS OF FUNCTIONAL ACTIVITY IN STRIATED MUSCLE AND THE SUBMAXILLARY GLAND. Trans. Roy. Soc., London, 207 (B): 149-182.

The oxygen intake (coefficient of oxidation), rates of salivary and muscular blood flow, exudation of water and lymph from the blood vessels of the two organs, flow of saliva, muscular weight changes, and the specific gravity of muscle are measured, discussed, and compared.

Bari, A., 1899. K VOPROSU O KORKOVYKH TSEN-TRAKH SLIŪNOTDELENIĀ [On the cortex centers of salivation]. Nevrolog. Vestnik, Kazan', 7 (4): 1-6.

In a preliminary study, the cortical salivary center was investigated in 14 trephined dogs under morphine-chloroform anesthesia by faradic stimulation of the cortex (12 to 15 cm. reel distance, thin platinum electrode); the submaxillary glands were cannulated. The salivary center was located in the gyrus suprasylvius anterior (coronalis). One to several drops of saliva was secreted after stimulation of these points during 10 to 30 seconds; salivary secretion usually stopped immediately after cessation of stimulation. The amount of saliva secreted on the heterolateral side was considerably larger than on the ipsilateral; in one case the opposite relationship was observed. Qualitatively, the salivary secretion corresponded exactly to chordal saliva; it was light, transparent and non-viscous. Occasionally, after multiple stimulation, several drops of very thick, whitish and viscous saliva, resembling sympathetic secretion were elicited. Muscular convulsions, produced experimentally for control purposes, elicited no salivation. Salivation appeared only when an epileptic fit was induced; its appearance can be explained by a diffusion of the salivary center.

Barker, S. A., E. J. Bourne, M. Stacey, and R. B. Ward, 1955. EFFECT OF STREPTOMYCIN ON VARIOUS ENZYMES RESPONSIBLE FOR SYNTHESIS AND DEGRADATIONS OF HIGHER SACCHARIDES. Nature (London), 175 (4448): 203-204, Jan. 29.

A study of streptomycin sulfate (0-15%) incubated with various enzyme solutions and suitable substrates is reported. Digests, with or without the streptomycin, were adjusted to the same pH to counteract the acidity of the antibiotic salt, and were analyzed for sugars periodically by paper chromatographic and ionophoretographic methods. No evidence was obtained of a streptomycinase, or of a transglycosylation producing modified streptomycins. Streptomycin sulfate was found to possess a modifying effect on some of the enzyme systems involved in the synthesis of higher saccharides. The hydrolysis of amylose by salivary α -amylase is inhibited slightly in the presence of 15% streptomycin.

Barlow, L. A., 1926. OBSERVATIONS OF SALIVARY SECRETION AND ASSOCIATED CLINICAL FINDINGS. Ann. Otol., Rhinol., Laryngol., 35 (4): 1021-1028.

A brief discussion of the embryology, anatomy, and nerve supply of the salivary glands is presented.

A chemical examination showed that 1000 grams of unstimulated saliva were composed of 995.16 g. H₂O; 1.62, epithelial tissue; 1.34, soluble organic material; 1.06, potassium sulphocyanide; and 1.82, inorganic salts [totalling 1001 grams]. Salivary pH was 6.60. Oral disturbances (cankrum oris or stomatitis) were found to have slight or no effect on the acidity of the saliva, the pH being a constant factor not affected by disease. Stomatitis, glossitis, and apthalia in persons over 40 years of age may be indicative of pernicious anemia, gastric acidity, or intestinal malignancy.

Barnard, R. D., H. A. Weitzner, and G. B. Gordon, 1949. THE RH PSEUDOAGGLUTINATIVE PROPERTIES OF PORCINE PAROTID MUCIN. Amer. Jour. digest. Dis., 16 (11): 401-405.

One kg. of porcine parotid tissue was physiologically and chemically processed, and approximately 15 g. of concentrated protein was salted out for use in the study.

For slide testing the hog extract was prepared with physiologic saline, bovine albumin, and human globin. A concentration of 3.5% parotid mucoprotein in saline solution proves optimal for causing agglutination of Rh negative red blood cells, but a 7% parotid extract-physiologic saline preparation though increasing the agglutination effects causes a confusing rouleaux pattern. Globin or albumin fortification increases the proclivity of the parotid mucoprotein to Rh positive erythrocytes.

Slide test data tabulations reveal that 265 and 249 of the 300 blood samples tested are positive for the IV-6 plasma fraction and porcine material, respectively. Tube testing (Wiener and Landsteiner method) shows the agglutination titer of the extract to vary from 1:64 to 1:1024, while the blocking antibody testing method, of Potter, shows no "blocking" effect to occur. In all three test findings there is significant correlation between the hog and human anti-Rh reagents. It is concluded that the pseudoagglutination is quite similar in both instances.

Barnes, H., and L. S. Fosdick, 1948. THE AMINO ACID CONTENT OF NORMAL AND HYDROLYZED SALIVA AND SALIVARY PROTEIN. Jour. dent. Res., 27 (6): 739-740.

In a study of the amino acid content of saliva, the free amino acid content, the total amino acid content after acid hydrolysis, and the amino acid content of the saliva after varying degrees of putrefaction were determined by means of paper chromatography. In most instances phenol and water were used as the partition fluids. It was found that the free amino acid concentration in saliva was exceedingly small; before any appreciable quantities could be determined the salivary proteins had first to be hydrolyzed.

Barnett, Charles W., and George V. Kulchar, 1939. THE INFECTIVITY OF SALIVA IN EARLY SYPHILIS. Jour. invest. Dermatol., 2 (6): 327-329.

Saliva, collected directly under sterile conditions from the parotid glands of each of 7 patients with untreated syphilis, was injected, in 1 cc. amounts into each of the testes of 2 rabbits. The animals were examined at frequent intervals, ranging from 17 to 40 weeks, popliteal lymph node transfers were made from these animals to other rabbits, and microscopic slide smears from the saliva were made and examined. In no case was there any evidence of syphilis. The authors suggest that infectivity of saliva in patients with syphilis probably is due to contamination from intra-oral lesions and that seminal fluid might be similarly infected by lesions within the genital tract.

Barnett, George D., and Robert G. Brankamp, 1929. INFLUENCE OF THE RATE OF SECRETION ON THE UREA CONCENTRATION OF SALIVA. Proc. Soc. exper. Biol. Med., 27 (2): 118-120.

Unstimulated and stimulated saliva samples, as well as blood samples from 18 subjects were examined for urea and ammonia. The mean values of the urea concentration were compared with those of the blood taken at the same time.

The urea content of whole unstimulated saliva was found to vary between 14.4 and 74.1 mg./100 cc., while that of paraffin-stimulated saliva varied between 11.6 and 45.3 mg./100 cc. The higher urea content of the unstimulated saliva is attributed in part to an accumulation of ammonium salts in the mucin. The urea content of the blood varied between 19.4 and 64.9 mg./100 cc.

Unstimulated parotid saliva varied from 11.9 to 45.4 mg./100 cc. of urea/100 cc., while stimulated parotid saliva varied from 9.1 to 32.3 mg./100 cc. Simultaneous blood samples varied from 11.8 to 49.3 mg. of urea. Only a slight amount of ammonia was found in the parotid salivas of the subjects.

When the secretion rate was increased from an average of 0.31 cc./min. to 1.39 cc./min., a diminution (average 7.2 mg. urea/100 cc.) was noted in the urea concentration.

Barnum, C. P., and W. D. Armstrong, 1942. PHOSPHATE EQUILIBRIUM BETWEEN PLASMA AND SALIVA. *Proc. Soc. exper. Biol. Med.*, 49 (1): 40-42.

Determinations were made of phosphorus (P) levels in the saliva and plasma of a 52-year old female cancer patient, who was administered a 4% solution (4 gm.) of sodium phosphate (containing radioactive P) by stomach tube. Salivary determinations were made of the P concentration and radioactivity of the supernatant of centrifuged samples of saliva collected 1, 3, and 24 hours after administration of the phosphate. Findings were compared to those determined in plasma, obtained midway in the collection of the second saliva sample, and in urine samples.

Results indicate that the peak radioactivity of the saliva occurred between 3 and 24 hours. Failure of the 3-hour saliva activity to reach the value equal to that of the plasma may be attributed to the simultaneous secretion of inactive phosphorus (stored in the salivary glands) and the active phosphorus derived from the plasma, at 3 hours when the blood was obtained, the specific activity of the plasma may still have been increasing. Urinalysis showed 15.8% of the radioactive phosphorus administered to be recovered in the urine. A higher retention rate may be obtained by subjecting the patient to a period of phosphorus starvation previous to radioactive phosphate administration. Experiments on rats had shown that, after phosphorus starvation, the loss of phosphorus in the urine is only about 1/60 the normal value.

Barrett, Louis G., 1922. THE ELECTRO-CONDUCTIVITY OF ORAL FLUIDS. *Dent. Cosmos*, 64 (12): 1352-1353.

An examination of the electrical resistance of samples of human saliva showed somewhat characteristic individual values which varied slightly with body changes. Examples are presented of 75 samples of saliva which varied in conductivity from .000177 mho to .013846 mho. Saliva from mouths exhibiting decay possessed low conductivity while saliva from mouths having extensive periodontoclasia usually possessed a very high conductivity.

Barron, L. E., 1932. REFLEX SALIVARY RESPONSES IN DEHYDRATION (LIMITED WATER INTAKE, HYPERTHYROIDISM). *Amer. Jour. Physiol.*, 100 (3): 559-563.

The relationship between salivary output and tissue dehydration was studied in four dogs. When the dogs were placed on unlimited water intake, there was no significant change in the reflex response of the submaxillary gland. When two dogs were kept on an average normal water intake (voluntarily consumed prior to thyroid feeding) plus 1 gram desiccated thyroid per kilogram body weight, dehydration was produced and the salivary response decreased. When the water intake of the other two dogs was gradually decreased, dehydration was also produced. Symptoms of dehydration preceded the reduction in salivary response in all cases. Salivary response in the dog is not considered to be a delicate measure of tissue dehydration.

Bartels, Henry A., 1932. SODIUM PERBORATE: PHYSICAL, CHEMICAL, AND BACTERICIDAL PROPERTIES. *Jour. dent. Res.*, 12 (3): 513.

A review of the physical, chemical, and bactericidal properties of sodium perborate is presented. A heaping teaspoonful of sodium perborate in a glass of water decreases the bacterial flora of fresh saliva by 50%, after 3 to 5 minutes exposure at 45°C. Sodium perborate loses its bactericidal power in the presence of blood. Streptococcus faecalis was more resistant to sodium perborate than were oral staphylococci or hemolytic streptococci.

Bartels, Henry A., 1933. BACTERIAL ASSOCIATION AS A LIMITING FACTOR ON THE BACTERIAL FLORA OF THE MOUTH. *Dent. Items of Interest*, 55 (8): 629-635.

In vitro cultural studies of oral and non-oral bacteria showed that a normal inhabitant of the mouth (a streptococcus of the viridans group) exerted an inhibitory effect on 4 of 5 air-borne microbes tested: inhibited were a white Gram-positive coccus, a yellow Gram-positive coccus, a Gram-positive bacillus, and a Gram-negative bacillus, while a Gram-positive spore-forming bacillus was not affected. Other microbes, part of the normal oral flora, probably exert similar effects.

Bartels, Henry A., 1934. THE PRESENCE OF LYSOZYME IN SALIVA AS A LIMITING FACTOR ON THE BACTERIAL FLORA OF THE MOUTH. *Dent. Items of Interest*, 56 (1): 8-11.

The lysozyme activity of saliva samples from patients having pyorrhea, hypertrophy of the gums, pregnancy gingivitis, carious teeth, painful burning tongue, edentulous mouths, and normal mouths was studied on cultures of Micrococcus lysodeikticus. Various dilutions of saliva were mixed with 1 cc. volumes of an opaque suspension of M. lysodeikticus in normal saline and kept in a water-bath (45°C.) for 1 hour. All the saliva samples were shown to contain lysozyme.

Lysozyme is not only effective against the test organisms used, but is active also against many other organisms.

Bartels, Henry A., 1950. BACTERIAL GROWTH AND CRYSTAL FORMATION: A POSSIBLE FACTOR IN CALCULUS FORMATION. *Jour. dent. Res.*, 29 (4): 436-439.

"The production of ammonium magnesium phosphate crystals about colonies of oral actinomycetes has been observed. Crystal formation resulted from an increase in alkalinity caused by decomposition of protein with liberation of ammonia which combined with the magnesium and phosphate components of the medium. This phenomenon is mentioned as a further corroboration of Naeslund's theory of salivary calculus formation." (Author's summary.)

Bartels, Henry A., 1951. BACTERIAL GROWTH AND CRYSTAL FORMATION. II. PRODUCTION OF CALCIUM CARBONATE CRYSTALS. Jour. dent. Res., 30 (5): 642-644.

"The formation of calcium carbonate crystals as a product of bacterial metabolism is recorded. The in vitro formation of crystals is of interest as a supplemental fact in the further corroboration of the Naeslund theory of salivary calculus formation." (Author's summary.)

Bartels, H. A., H. Blechman, and J. Cavallaro, 1958. THE IN VITRO INHIBITION OF BETA HEMOLYTIC STREPTOCOCCI BY SALIVA. Jour. dent. Res., 37 (1): 50.

Since beta hemolytic streptococci appear only as occasional members of the oral microbiota, saliva was examined to determine if a specific anti-hemo-streptococcal factor was present. Heated and unheated saliva, 25 percent by volume, was added to a basal medium of brain heart infusion agar. The surface was streaked with test microorganisms: Micrococcus lysodeikticus, Micrococcus aureus, Bacillus cereus, Neisseria flavescens and various strains of beta hemolytic streptococci. Over 200 specimens of saliva collected from 16 different normal individuals at various times were examined. It was found that an anti-beta hemolytic streptococcal factor was present in fresh saliva. The factor is distinct from lysozyme, not filterable through the Seitz sterilization filter, and is associated with the oral microbial flora. It inhibits the growth of both stock and recent beta hemolytic streptococcal isolates. Since this action is manifested in the presence of laked blood, potato juice, lyophilized catalase, and under anaerobic conditions, we conclude it is distinct from the hydrogen peroxide production by oral microorganisms. (Author's abstract)

Bartels, H. A., H. Blechman, and J. Cavallaro, 1958a. THE INHIBITORY ACTION OF SALIVA ON THE IN VITRO GROWTH OF BETA HEMOLYTIC STREPTOCOCCI. Jour. dent. Res., 37 (4): 654-660.

Full revised form of Bartels, et al (1958.).

Baschmakoff, W. J., 1923. DIE REFLEKTORISCHE ABSONDERUNG DES SPEICHEL AUS EINER DRÜSE MIT DURCHSCHNITTENEN SEKRETORISCHEN NERVEN [The reflex secretion of saliva from a gland having severed secretory nerves]. Pflüger's Arch. ges. Physiol., 200 (1-2): 379-391.

The excretory duct of the submaxillary glands of anesthetized and curarized cats were cannulated. Both secretory nerves were severed and isolated. A 0.1% pilocarpine solution was injected into the blood while the isolated great sciatic and in certain cases the splanchnic nerves were connected to electrodes.

One of the glands was treated with pilocarpine and both secretory nerves were severed. When the stump of the great sciatic nerve was electrically stimulated, salivation of the affected gland increased somewhat but soon slowed down to pre-stimulation values. Stimulation of the peripheral end of the splanchnic nerves did not induce such a marked increase in salivation. The injection of epinephrine into the blood increased salivary secretion considerably in the affected gland and also somewhat in the control gland.

A short stimulation of the chorda with induction current resulted in considerable salivation. When blood was taken from the suprarenal vein during stimulation of the severed sympathetic nerve, the quantity of epinephrine in the adrenal blood increased. This epinephrine quantity, however, was not sufficient to stimulate the secretion of the submaxillary gland unless the gland was previously stimulated through the chorda or with pilocarpine.

Basir, M. A., and T. S. Ramabhadran, 1937. A STUDY OF HUMAN PAROTID SALIVA. Indian Jour. med. Res., 24 (3): 911-916.

Salivary samples were obtained from a patient with an ipsilateral facial injury. Information is given concerning the physical properties of the secretion and the saccharogenic powers of mixed and parotid samples. Human parotid saliva in Ringer's-cardiac perfusion fluid demonstrably depressed the cardiac action of a frog's heart in the systolic stage. Atropine and nicotine were found to enhance the parotid salivary effect on the heart.

Human parotid secretion, it is concluded, differs from acetylcholine in that it inhibits the heart in systole and its depressant action upon the cardia is not annulled by previous administration of atropine and nicotine.

Basu, K. P., and S. Mukherjee, 1936. BIO-CHEMICAL INVESTIGATIONS ON DIFFERENT VARIETIES OF BENGAL RICE. III. ENZYMATIC DIGESTIBILITY OF RICE STARCH AND PROTEIN: ACTION OF SALIVARY AND PANCREATIC AMYLASE AS WELL AS OF PEPSIN AND TRYPSIN. Indian Jour. med. Res., 23 (3): 777-787.

In a study of the digestibility of variously treated varieties of rice, stimulated saliva acting over a 15-minute period was found to produce from 18.75 to 21.68 mg. of reducing sugar (mean value, 20.35 mg.) from AUS varieties of the rice. Similar tests with AMAN varieties showed the amounts of sugar to vary between 22.08 and 23.45 mg. (mean value, 23.08 mg.).

Basu, K. P., and S. Mukherjee, 1936. ENZYMATIC DIGESTIBILITY OF PULSES: ACTION OF SALIVARY AND PANCREATIC AMYLASE AND OF PROTEOLYTIC ENZYMES PEPSIN AND TRYPSIN. Indian Jour. med. Res., 23 (3): 827-830.

In a study of the digestibility of various legumes by salivary amylase over a 15-minute period, lentils (Lens esculenta) were found to yield 12.56 mg. of reducing sugar; peas (Pisum arvense), 10.61 mg.; green gram (Phaseolus mungo), 11.05 mg.; gram (Cicer arietinum), 9.12 mg.; white soybean, 10.06 mg; and black soybean, 9.97 mg. Salivary amylase activity was more marked than that of the pancreas on the lentil, the green gram, and the gram.

Bates, J. F., 1958. EFFECT OF INGESTED CARBOHYDRATES ON THE CONCENTRATIONS OF AMYLASE, ORTHOPHOSPHATES AND CARBON DIOXIDE IN HUMAN PAROTID SALIVA. *Jour. dent. Res.*, 37 (4): 755-756.

Possible adaptation of the parotid glands to ingested carbohydrates has been investigated. (1) A comparison of the composition of saliva stimulated by wax and barley sugar has been made, and the results show that differences in the salivary composition are due to differences in the rates of secretion. This suggests that reflex stimulation of the salivary glands results in the same composition of saliva irrespective of the type of stimulant. (2) Changes in the composition of the blood may cause changes in the composition of the saliva and in order to investigate this, experiments were conducted with the following results: (a) No change was found in the amylase concentration of wax-stimulated saliva in 5 subjects who reduced their carbohydrate intake for a period of 4 weeks. (b) Infusions of phosphate buffers (plasma levels of up to 3.0 mM/L.) cause a 7 percent rise in the phosphorus of wax-stimulated saliva. Hydrocortisone infusions and glucose taken by mouth had no effect on phosphorus levels of wax-stimulated saliva. (c) Glucose ingestion caused no change in the carbon dioxide concentration of wax-stimulated saliva. (Author's abstract)

Battez, G., and E. Duvillier, 1913. ACTION DES SUBSTANCES HYPOTENSIVES SUR LA SÉCRÉTION SALIVAIRE [The effect of hypotensive substances on salivary secretion]. *Compt. rend. Soc. Biol. (Paris)*, 74 (21): 1230-1232.

Experiments on a curarized dog with unilateral section of the submaxillary gland nerves showed that inhalation of amyl nitrite caused salivation on the intact side of the mouth as the blood pressure began to drop. Thus amyl nitrite does not affect the peripheral elements of the gland directly. An acid extracted from the mucosa of the large intestine and neutralized, also a hypotensor, and an extract from the mucosa of the ileum gave similar results. The extract from the large intestine occasionally elicited a drop of saliva from the denervated gland. This effect was more frequent and more marked when extract from the ileum was used.

Bauchwitz, Otto E., 1930. VERSUCHE ÜBER DEN EINFLUSS DES RAUCHENS AUF MUND UND ZÄHNE ÜBER REAKTIONÄNDERUNG DES SPEICHEL DUREH RAUCHEN [Experiments on the influence of smoking on the mouth and teeth and on reaction changes of saliva caused by smoking]. *Zahnärztl. Rundschau*, 39 (29): 1241-1246.

An extensive review of the literature on the effects of smoking on saliva and on the oral cavity.

Bauer, Charles W., and W. F. Martin, 1948. THE STABILITY AND SALIVARY AMYLASE. *Jour. Amer. pharm. Assoc.*, 37 (5): 188-191.

A study was made of the factors influencing the stability and activity of salivary amylase. All salivary samples were collected after breakfast since the salivary amylase was found to be most active at this time; all digestion mixtures were kept at 40° C, buffered to pH 6.8, and activated by sodium chloride. The progress of digestion was followed by testing with a dilute iodine solution.

The amylase in saliva was found to be much more active when first collected than it was 1 hour later; loss of this labile activator was not prevented by toluene. A preservative action of toluene on amylase activity was noted in salivary samples that were stored at room temperature for 34 days. Storage of saliva at 50° for 1 hour did not affect amylase activity while storage at 60° for 1 hour completely destroyed it. The storage of saliva at 2° for 1 week had an activating effect on salivary amylase.

A comparison was made of the amylase activity of normal subjects and subjects with skin eruptions. The activity of amylase varied from person to person in all cases. A digestion time of 1 to 6 minutes was noted in 150 normal subjects while the digestion time of 79 subjects with skin eruptions varied from 1 minute to over 1 hour. It is suggested that people with skin eruptions may have a sluggish salivary amylase activity.

Bauer, Charles W., and E. V. Svedres, 1951. SALIVARY AMYLASE: ITS ACTIVITY AND STABILITY WITH THE EVIDENCE FOR THE EXISTENCE OF A LABILE FRACTION. *Jour. Amer. pharm. Assoc.*, 40 (11): 545-550.

A study was made of the influence of various factors on the stability and activity of salivary amylase and of the existence of a labile fraction of the salivary amylase. Undiluted saliva, protected by froth or a layer of preservative, was found to retain its maximum amylase activity for at least 1 week. The amylase activity of saliva diluted with distilled water was found to deteriorate to half its initial activity in fifteen minutes; the remaining amylase was then very stable for several weeks. Further studies indicated that the oxygen dissolved in the distilled water destroyed the labile portion of the salivary amylase and that it could also be destroyed by direct aeration; the inactivating effect of oxygen appeared to be proportional to the amount of dissolved oxygen. The remaining portion of the enzyme in saliva was oxygen-stable.

Physical fatigue of the jaws after 4 hours mastication had no effect on the activity of the amylase in the saliva secreted; chewing penicillin troches and sulfathiazole gum also had no effect on amylase activity. However, both the oxygen-stable and oxygen labile forms of the enzyme were destroyed by heating to 60° for 1 hour and by the action of dilute hydrogen peroxide.

Nicotinic acid, ascorbic acid, nicotinamide, monosodium glutamate and some amino acids were all found to have an inactivating effect on the oxygen-labile portion of salivary amylase.

No labile fraction of amylase was found in commercial forms of pancreatin, malt extract, α -amylase, or β -amylase.

It is suggested that irregular results and great individual variations in assays of salivary amylase may be due to methods of analysis in which the inactivating effect of oxygen is not considered.

Baxter, Hamilton, 1929. THE COMPOSITION OF THE SALIVA IN DIFFERENT PHASES OF THE SECRETION AND BY REPEATED STIMULATION. *Amer. Jour. Physiol.*, 91 (1): 132-142.

Experiments were performed on a dog with a permanent parotid fistula. The saliva was collected and analyzed for total solids, organic substances, and ash. Certain improved methods

of determination were devised. Total solids, organic matter, and inorganic matter were determined by weighing dried saliva samples, and the ash obtained after controlled combustion in platinum crucibles not exceeding 540°C.

In one set of experiments the secretion was stimulated by different substances for one minute and the saliva was collected for one minute and 30 seconds. Three applications of the chemical stimuli were given at 0 sec., at 30 sec., and at 60 sec. No significant difference in the amount of organic matter was detected after stimulation with HCl and NaCl.

In a further study, three separate specimens of saliva were collected: a) the first minute during stimulation; b) after-flow during the second minute; c) after-flow from the third to the seventh minute inclusive. In every instance saliva of the second period showed a greater percentage of organic matter than that of the first minute. The secretion collected from the third to the seventh minute, was characteristically poorer in total solids and especially in organic constituents.

Several experiments were performed on the effect of repeated stimuli (feeding with meat and bread powder); the intervals between stimuli varied from zero to 13 minutes and the saliva was collected for 1 min. and 30 sec. The content of organic substance in the parotid saliva of the second feeding was greater only when the interval between the first and second feeding was less than one minute.

Experiments on the relationship between viscosity and total organic matter indicated that there is no exact proportionality between the amount of organic substance in the submaxillary saliva and its viscosity.

Baxter, Hamilton, 1931. FURTHER STUDIES ON THE COMPOSITION OF SALIVA IN DIFFERENT PHASES OF THE SECRETION. *Amer. Jour. Physiol.*, 97 (3): 450-458.

In continuation of an earlier investigation (Baxter, 1929m), the author studied the composition (organic matter, ash, and chlorides) of saliva in a four-phase experiment. The phases were designated as 1(A), 1(B), 2, and 3; the first phase being separated into two equal periods. Experiments were performed on 5 dogs with permanent salivary fistulae in the parotid and submaxillary glands. Each animal was stimulated at 15-min. intervals not more than 4 times during an experiment. Stimulation was produced by various agents: bread and meat powder, hydrochloric acid, sodium chloride, and electrical stimulation of the chorda tympani.

Secretion was stimulated in 3 dogs for one-minute periods with bread and meat powder, 25% HCl or 10% NaCl. The amounts of saliva collected represented the total volume of saliva in each phase, secreted during the four consecutive stimulations. The greatest concentration of organic substances in the parotid saliva was obtained in phase 1(B) or phase 2. Both the organic and ash fractions were lower in phase 1(A) than in phase 1(B). "The average concentration of the organic moiety in phases 1(A) and 1(B) was usually lower than in phase 2."

Experiments were performed on a dog with fistulae of the parotid and submaxillary (mixed type) glands. The mixed glands also exhibit phases of secretion. The ash percentage was

usually lower in the mixed gland saliva than in the parotid saliva. The secretion from the mixed gland, however, was always more copious than that of the parotid. The percentage of organic matter varied less in the mixed gland than it did in the parotid saliva.

In saliva (parotid and mixed glands) the chlorine diminishes steadily from 1(A) to phase 3 independently of the organic fraction and ash and of the rate of secretion.

Pilocarpine hydrochloride (2.5 to 3 mg.) was injected subcutaneously. Saliva was collected during 5-minute periods over approximately 1 hour, and the contents of solids, organic material, and ash were analyzed. The concentration of organic material in the first 5-minute period ranged from 0.30 to 0.50%, rapidly declining during successive periods to as low as 0.10 to 0.08%. The ash gave similar results, falling to about 0.30%.

Experiments with atropine were performed on 4 dogs with parotid fistulae. Atropine sulfate, administered in increasing amounts, caused a reduction in the percentage of ash and an abolition of the phase rise in organic moiety.

Baxter, Hamilton, 1931a. THE INFLUENCE OF SECTION OF THE CERVICAL SYMPATHETIC NERVE AND EXTIRPATION OF THE SUPERIOR CERVICAL GANGLION ON THE COMPOSITION OF THE PAROTID SALIVA IN THE DOG. *Amer. Jour. Physiol.*, 97 (4): 668-675.

Changes in composition of parotid saliva in 2 dogs following section of the cervical sympathetic nerve include a drop in the organic substances of the saliva in phase 1A. The total concentration of the organic matter in phases 1A and B showed no change immediately after removal of the sympathetic innervation but did show a rise some months later. A rise in the salivary organic matter noted during phase 1B and 2, is attributed to the varying state of excitation of the salivary center rather than to vascular changes. No changes occurred in the inorganic fraction or in the concentration of chlorine, or in the organic matter of phase 3. In experiments with pilocarpine, the saliva was found poorer in all its constituents after sympathectomy. Three months later the parotid gland reacted almost normally to the various stimuli. In experiments with atropine, slightly less than normal secretion of the gland was noted after section of the sympathetic nerve. Extirpation of the superior cervical sympathetic ganglion in one of the experimental dogs resulted in changes in the quantity of organic matter secreted and in the concentration of chlorides in the different phases. The concentration of inorganic salts was almost unchanged. Salivary changes following sympathectomy are attributed to a varying state of the salivary center rather than to changes in vascularization, and to the absence of special motor impulses transmitted to the gland, reflexly by the nerve. Extirpation of the ganglion accentuated the relatively lower concentration of organic matter in phase 1A as compared with phase B. The increased blood supply probably caused the increase of the absolute concentration of organic matter.

Extirpation of the superior cervical sympathetic ganglion in one of the experimental dogs resulted in salivary changes in the quantity of organic matter and in the concentration of chlorides in the different phases. The relatively lower concentration of organic matter in phase

1A as contrasted with phase B was accentuated. The increase noted in the absolute concentration of organic matter is considered as probably due to the increased blood supply. The concentration of organic salts was almost unchanged by the extirpation.

Baxter, Hamilton, 1933. VARIATIONS IN THE INORGANIC CONSTITUENTS OF MIXED AND PAROTID GLAND SALIVA ACTIVATED BY REFLEX STIMULATION IN THE DOG. *Jour. biol. Chem.*, 102 (1): 203-217.

"1. A study was made of the inorganic composition of saliva obtained from the parotid and mixed glands by reflex stimulation and subcutaneous injection of pilocarpine in dogs with permanent salivary fistula.

"2. The concentration of chlorine and calcium and the acid-combining power are considerably lower in the saliva of the mixed glands than in the parotid saliva. No great difference could be observed in the potassium concentration of either saliva, but the concentration of phosphorus was somewhat higher in the saliva of the mixed glands.

"3. Different stimuli acting on the receptive surface of the mouth cavity may produce from either the parotid or the mixed glands a flow of saliva of equal volume but of different inorganic composition. Under some stimuli these variations are very small, under other quite marked.

"4. By diminishing the strength of solutions of NaCl and HCl introduced into the mouth, the volume of the secretion is also diminished. The reaction of the mixed glands to NaCl is stronger than to HCl; the reverse is the case in the parotid gland.

"5. When the strength of the stimulus was diminished, the concentration of chlorine and the acid-combining power fell. No changes or only very slight ones were noted in the concentration of calcium and potassium ions under these conditions.

"6. The chlorine, calcium, and potassium concentrations were much lower in the parotid saliva activated by pilocarpine than in the parotid saliva secreted at the same rate on meat extract or bread and meat powder, while the acid-combining power was equal in the two salivas, or somewhat higher in the saliva activated by pilocarpine." (Author's summary.)

Detailed analyses of salivas for solids, organic matter, ash, chlorine, calcium, phosphorus, potassium, acid-combining power are given in Tables I to IV.

Bayliss, W. M., and L. Hill, 1894. ON THE FORMATION OF HEAT IN THE SALIVARY GLANDS. *Jour. Physiol. (London)*, 16: 351-359.

A study was made of the formation of heat in the salivary glands of the dog under varying conditions of stimulation of either the chorda tympani or of the cervical sympathetic nerves. No measureable amount of heat was demonstrated in the salivary glands by any known method of measuring variations in temperature.

Beach, J. Wright, 1908. THE SALIVA AND TOOTH DECAY. *Dent. Cosmos*, 50 (5): 469-472.

On the basis of 3 years clinical experience covering the testing of about 300 specimens of saliva, the author considers the presence of

potassium thiocyanate in the saliva to inhibit development of caries and to clear up the oral field generally.

Beck, D. J., D. I. Bayne, G. H. Davis, and B. G. Bibby, 1958. ATTEMPTS TO MEASURE TOTAL ACID POTENTIAL OF FOODSTUFFS. *Jour. dent. Res.*, 37 (1): 73.

Work has been directed toward finding a more suitable technic for rapidly measuring acid production from common foodstuffs by saliva. A technic of neutralization with alkali at regular intervals during the course of fermentation was used, as it was felt this technic would give a more accurate measure of the total acid potential of foodstuffs. The techniques of titration at the end of the test period only and measuring pH changes during fermentation were also employed. From the results achieved using these methods the following conclusions were drawn. Regular neutralization during the course of fermentation yields much higher titratable acidity than does terminal neutralization alone. The initial pH of the substrate and the substrate/saliva mixture greatly affects the fermentation, acid production being less from an acid substrate. Aeration during fermentation has no apparent effect on acid yield. Salivary sediment causes a more rapid initiation of fermentation than does whole saliva, but total acid production is greater from whole saliva. In an effort to explain these differences, buffering capacity and the effect of amylase were studied. These studies show that whole saliva and salivary supernatant have very similar buffer curves, but sediment has little buffering capacity. The addition of amylase to sediment does not apparently enhance fermentation. (Author's abstract)

Becker, H., and E. Kestermann, 1936. ÜBER DAS VORKOMMEN VON TRAUBENZUCKER IM MENSCHLICHEN SPEICHEL [On the occurrence of grape sugar in human saliva]. *Deutsch. Arch. Klin. Med.*, 179 (3): 232-237.

Saliva samples taken before breakfast and samples stimulated by a meal of 400 g. vegetables and 100 g. fried meat, were collected from 10 healthy persons over a 30-minute period. The mucin was removed by precipitation and the samples were analyzed for grape sugar content (dextrose). The preprandial blood sugar values ranged between 70 and 105 mg./100 cc., showing an increase in the majority of the samples within 20 minutes after breakfast. The sugar in preprandial saliva was scant, if present at all; even 20 minutes after feeding, values were insignificant. The flow of preprandial salivas of 8 persons ranged between 5.6 and 9.6 cc. (per minute?); 20 min. after feeding, it ranged between 7.4 and 10.1.

In 23 diabetics, dextrose was contained in salivas in considerable amounts. The preprandial values of blood sugar ranged from 92 to 338 mg./100 cc.; 20 minutes after the meal, values had increased in the majority of cases. The dextrose content of the preprandial saliva, with three exceptions in which it was absent, ranged from 4 to 21 mg.; 20 min. after feeding, dextrose was present in all cases, and ranged from 2 to 24 mg./100 cc. The amount of preprandial saliva secretion ranged from 0 (in 2 cases) to 1.5 to 7.8 cc.; 20 min. after breakfast, it ranged from 2.1 to 10.5, and was present in all subjects.

Occasionally, there appeared to be a direct correlation between salivary amount and the sugar concentration of saliva. In general, despite the increase in salivary secretion, the salivary dextrose content remained constant.

Becks, H., 1928. ELECTROLYTES OF SALIVA UNDER NORMAL AND PATHOLOGICAL CONDITIONS. *Proc. Soc. exper. Biol. Med.*, 26 (2): 93-95.

Resting saliva of persons with intact teeth and gum tissues was examined in order to obtain normal values for electrolytes and thus to establish a foundation for the study of saliva under pathological conditions. The following average values were obtained (all in mg. per 100 cc.): HCO_3 , 93.16; K, 55.89; Ca, 12.13; Mg, 1.29; Cl, 74.68; PO_4 , 13.16; and CNS, 30.9. The average pH was 7.15.

A study of the electrolyte composition of saliva during one day revealed that the values for potassium and sulfocyanide were lowest in the morning, and highest in the afternoon and that calcium and chloride values were opposite to these. Magnesium, present in relatively small amounts, seemed to be inversely proportional to sodium. No constant values could be determined for phosphorus (PO_4), HCO_3 , and pH.

The hydrogen ion concentration of the parotid saliva, being primarily acid, was fundamentally different from that of the mixed saliva of the same individual, the submaxillary and sublingual secretions being in the alkaline range.

A negatively charged calcium compound, thought to be the main factor in tartar formation, was present in saliva.

That saliva is not a saturated solution of $\text{Ca}_3(\text{PO}_4)_2$ and CaCO_3 was proven by a special mode of experimentation [neither named nor described].

Mixed saliva, collected from pyorrhea patients, showed a noticeable increase of cations over the values obtained for normal individuals. K and Na values in particular were higher; a reduction of approximately 25% occurred in Ca and PO_4 , and of 40% in Mg.

In salivas obtained during pregnancy, the Mg content was increased and the Ca content reduced to approximately 50% of the normal value.

Becks, H., and W. W. Wainwright, 1934a. HUMAN SALIVA. I. CRITICAL DISCUSSION OF FORMER SALIVARY CALCIUM STUDIES AND THEIR VALUE IN THE ESTABLISHMENT OF NORMAL STANDARDS. *Jour. dent. Res.*, 14 (5): 387-423. Advance abstract: *Jour. dent. Res.*, 14 (3): 161-162.

An extensive and critical review of findings concerning the calcium content of saliva is presented. Other papers of this series under Wainwright, 1934m; 1938m; 1939m,n; 1943m; 1944m; 1946m.

Becks, H., and W. W. Wainwright, 1938. HUMAN SALIVA. III. CRITICAL DISCUSSION OF FORMER SALIVARY PHOSPHORUS STUDIES AND THEIR VALUE IN THE ESTABLISHMENT OF NORMAL STANDARDS. *Jour. dent. Res.*, 17 (3): 197-215.

An extensive critical review of salivary phosphorus studies is presented. Several tables and graphs, integrating the various findings are included.

Becks, H., 1938a. HUMAN SALIVA. IV. CRITICAL DISCUSSION OF FORMER STUDIES OF THE DISTRIBUTION OF SALIVARY PHOSPHORUS FRACTIONS. *Jour. dent. Res.*, 17 (3): 217-234.

An extensive review is presented concerning the various methods used to determine the distribution

of phosphorus fractions in saliva. The results obtained by these methods are also discussed.

Becks, H., and W. W. Wainwright, 1939. HUMAN SALIVA. IX. THE EFFECT OF ACTIVATION ON SALIVARY FLOW. *Jour. dent. Res.*, 18 (5): 447-456.

A comparison was made of the rate of flow of resting and of paraffin-stimulated saliva in 30 individuals, 15 of whom had a normal (unstimulated) rate of flow less than 20 cc./hr., the others had a normal flow in excess of 20 cc./hr. Determination of the normal rate of flow during 15 minutes showed the low-salivation rate group (group I) to average 9 cc./hr. Activation of salivary flow, effected by chewing 1 gm. of paraffin 450 times, resulted in an average rate of flow of 103 cc./hr. in Group I individuals, and of 89.2 cc./hr. in Group II individuals. When collection of saliva was continued after the initial period of activation results of 8 successive periods of paraffin-stimulation showed the percentage change in activated salivation rate (from the resting value) to decrease from the initial 1,185 to 923.2 in Group I, and to increase in Group II from 128.8 to 144.8 in Group II.

Becks, H., 1939a. HUMAN SALIVA. VII. A STUDY OF THE RATE OF FLOW OF RESTING SALIVA. *Jour. dent. Res.*, 18 (5): 431-440.

The fluctuations in the rate of flow of resting saliva over various time periods were studied.

Four to six saliva samples were collected from each of 40 individuals over a period of from 1 to 2 years; measurements were made using a conical 15 cc. pyrex centrifuge tube. The individuals were divided into two groups: Group I consisted of 20 individuals having rate of salivary flow up to 20 cc./hr., Group II, 20 individuals with higher flow rates. The average rate of flow for individuals in Group I was 13.4 cc./hr.; the average fluctuation was 5.4 cc./hr. (of 59.2%). The average values for Group II were 39.6 cc./hr. and 24.6 cc./hr. (or 82.8%), respectively. The values indicate that the lower the rate of flow of resting saliva the less fluctuation occurs over a period of 1 to 2 years, and the higher the rate of flow the greater the fluctuation.

The rate of flow of 20 individuals, separated as in the preceding study, was observed for 5 successive days. The average rate of flow for Group I was 14.0 cc./hr. with a fluctuation of 4.5 cc./hr. (or 50.2%). The average values for Group II were 39.9 cc./hr., and 15.9 cc./hr. (or 56.7%), respectively. No pronounced differences of fluctuation were observed.

Fluctuations in flow were measured during continuous collection for 9 individuals. The individuals were separated as before, with 4 individuals in Group I and 5 in Group II. The salivas were collected continuously for 2-1/2 hours. The average rate of flow for group I was 12.6 cc./hr. with an average fluctuation of 11.7 cc./hr. (or 74.8%). For Group II, the values were 49.1 cc./hr. and 16.1 cc./hr. (or 40.9%), respectively. This marked difference in percentage fluctuations indicates that the lower the initial rate of flow of resting saliva the greater the fluctuation during 2-1/2 hours of continuous collection, and vice versa. Because the fluctuations occurred in the main after 60 minutes of continuous collection, the values for the first hour of collection were recalculated. The average flow of Group I was 9.6 cc./hr. with an average fluctuation of 4.8 cc./hr. (or 64.1%). For Group II,

the average flow was 45.7 cc./hr.; the average fluctuation, 4.2 cc./hr. (or 10.2%).

A comparison of percentage fluctuations of the 1 hour and the 2-1/2 hour studies shows that the fluctuation decidedly increases in both Group I (from 64.1% to 174.8%), and in Group II (from 10.3% to 40.9%), after 1 hour.

The author believes that such fluctuations of flow rate necessarily affect the analytical results for calcium and phosphorus expressed in mg./100 cc. as well as mg./hr.; the importance of indicating the total time of collection for the interpretation of results is stressed.

Becks, H., 1941. HUMAN SALIVA. X. FLUCTUATIONS OF CALCIUM AND PHOSPHORUS CONTENT OF RESTING SALIVA. Jour. dent. Res., 20 (6): 627-636.

The calcium and phosphorus contents of resting saliva of 40 individuals on different days were studied over a two-year period. The individuals were divided into groups by rate of salivary secretion [as previously, cf. Becks, 1939m] and fluctuations were calculated and expressed in averages and percentages. The average rate of secretion for calcium in Group I (slow producers) was 5.99 mg./100 cc., being higher than that for Group II (fast producers), 5.66, indicating a relationship between rate of flow and calcium content. This difference was more pronounced in phosphorus values (17.0 mg./100 cc. against 11.8 mg./100 cc., respectively).

Differences in average mg./100cc. fluctuations between Groups I and II (calcium, 1.21 and 1.44 mg./100 cc. and phosphorus, 4.9 and 4.4 mg./100 cc., respectively) were insignificant but an inverse relationship between mg./100 cc. values to rate of flow was indicated.

In contrast to the mg./100 cc. values, the mg./hr. calculations were decidedly different in the two groups. The average values (those for group II in parenthesis) were: calcium, 0.80 (2.26) mg./hr. and phosphorus, 2.21 (4.42) mg./hr.; average fluctuations of mg./hr. were: for calcium, 57.07 (100.6%) and for phosphorus, 56.7 (75.1%). The authors conclude that: "1, the lower the original rate of flow [resting saliva], the higher are the average mg. percent and the lower the mg./hr. calcium and phosphorus values; ... inconsistent with Heidenhain's law; 2, the fluctuations of mg./hr. figures are far greater than mg. percent figures; 3, as was observed in the fluctuations of rate of flow of [resting saliva] ..., Group I shows less fluctuations than Group II; 4, the rate of phosphorus secretion (mg./hr.) is far less influenced by an increase of rate of flow than is calcium."

Two to nine resting-saliva samples were collected from each of 7 individuals (4 from Group I, and 3 from Group II) at 15-minute intervals over 2-1/2 hours. The average values were (Group II in parenthesis): Rate of flow, 12.6 (31.6) cc./hr.; the total calcium, 5.79 (5.16) mg./100 cc.; and the average inorganic phosphorus, 22.6 (13.4) mg./100 cc. The mg./100 cc. fluctuations for calcium were 1.41 (1.45) and for phosphorus, 5.6 (2.8) mg./100 cc.

The percentage fluctuations for calcium mg./100 cc. was 29.3 (34.8); for phosphorus, 29.3 (24.0) mg./100 cc. In mg./hr., a distinct difference occurred between the two groups: the mg./hr. fluctuation for calcium was 0.42 (1.34) and for phosphorus, 1.64 (2.34) mg./hr.

Considering only the first hour of the experiment, the average calcium value was 7.08 (5.45) mg./100 cc. and the average phosphorus, 21.8 (13.45) mg./100 cc.; the average mg./hr. for calcium was 1.09 (1.89) and for phosphorus 3.40 (4.30); fluctuations in mg./hr. were 0.20 (0.73) for calcium and 1.20 (1.33) for phosphorus, percentage fluctuations were 20.2 (44.8) for calcium and 42.9 (37.4) for phosphorus.

A comparison of the mg./hr. fluctuations of the 2-1/2 hours study with the 1 hour study indicated the necessity of knowing the original flow rate and duration of collection time for correct biological interpretation.

The results obtained were in direct contrast to Heidenhain's law which stipulates that the salivary calcium and phosphorus values increase in direct proportion to the increase in salivary secretion (electrically stimulated); the mg./100 cc. calcium and phosphorus values decrease with higher secretion rates and vice versa.

Becks, H., and W. W. Wainwright, 1941a. HUMAN SALIVA. XI. THE EFFECT OF ACTIVATION ON SALIVARY CALCIUM AND PHOSPHORUS CONTENT. Jour. dent. Res., 20 (6): 637-648.

Effects of paraffin stimulation on salivary composition were studied. Resting-saliva samples were collected from 10 individuals---5 in Group I (slow producers, averaging 9.40 cc./hr.) and 5 in Group II (rapid producers, averaging 37.20 cc./hr.). The individuals then chewed paraffin for 8 periods of 450 chews each and saliva samples were collected over an average of 45 minutes each.

Average resting-saliva values for Group I (Group II in parenthesis) were: Calcium, 6.21 (4.72) mg./100 cc. and 0.60 (1.72) mg./hr.; and phosphorus, 17.60 (12.00) mg./100 cc. and 1.62 (4.41) mg./hr.

Average values after the first period (450 chews) for Group I (Group II in parenthesis) were: rate of flow, 101.20 (88.00) cc./hr.; calcium, 4.32 (4.17) mg./100 cc. and 4.44 (3.92) mg./hr.; and phosphorus, 10.60 (11.10) mg./100 cc. and 11.16 (9.56) mg./hr.

These results confirm previous findings [cf. Becks, 1941m] that a greater percentage increase in secretion rate from resting to activated saliva occurs in the slow producers than in the normally fast ones.

Activation was continued for 45 minutes and samples were collected after the first, third, and eighth periods of 450 chews each (cf. Table II).

After continuous stimulation of 45 minutes, the average values for Group I (Group II in parenthesis) were: Calcium, 3.91 (3.69) mg./100 cc. and 3.50 (3.20) mg./hr.; and for phosphorus, 9.5 (10.7) mg./100 cc. and 8.75 (9.11) mg./hr. The average rate of flow was 86.6 (87.1) cc./hr.

Average values calculated for the first 18 3/4 minutes (average) on the basis of three successive samples (450 chews each) were: Calcium, 4.04 (3.97) mg./100 cc. and 3.72 (3.45) mg./hr.; and for phosphorus, 9.4 (10.8) mg./100 cc. and 8.93 (9.01) mg./hr. The average rate of flow was 90.7 (83.2) cc./hr.

Fluctuations for all the above values are presented.

It appears, therefore, that during 45 minutes of continuous stimulation, the average mg./100 cc.

and mg./hr. values of calcium and phosphorus decrease during the first half of the activation; thereafter, the calcium values continue to decrease while the phosphorus values gradually plateau. The possibility was indicated that after long continuous stimulation, the salivary composition may become constant.

Confirming earlier observations, [cf. Becks, 1941m], the response of salivary composition (calcium and phosphorus) does not follow Heidenhain's law; moreover, the activated saliva is not considered suitable for comparative purposes.

This paper contains a summary of papers X and XI in this series.

Becks, H., W. W. Wainwright, and D. H. Young, 1941b. DOES SALIVARY CALCIUM AND PHOSPHORUS COMPOSITION DIFFER SIGNIFICANTLY IN CARIES-FREE AND CARIES-ACTIVE INDIVIDUALS? *Jour. dent. Res.*, 20 (3): 171-188.

Saliva samples of 90 caries-free individuals (11-53 years of age) and 108 carious individuals (10-58 years of age) were analyzed for calcium and phosphorus content; rates of salivary flow were determined. Average values obtained were as follows (those for carious individuals in parenthesis): rate of flow, 19.00 cc./hr. (17.00); calcium, 6.48 mg./100 cc. or 1.14 mg./hr. (6.06 mg./100 cc. or 0.99 mg./hr.); and phosphorus, 15.33 mg./100 cc. or 2.76 mg./hr. (15.33 mg./100 cc. or 2.40 mg./hr.). No differences of statistical significance were observed between the two groups.

Extremes of age and rate of flow had a decided influence upon calcium and phosphorus values, regardless of the presence or absence of caries. When the extremes were eliminated, the averages for the two groups of individuals were practically identical, the average ranges being as follows (those for carious individuals in parenthesis): rate of flow, 11.2--49.2 cc./hr. (11.0--48.0); calcium per 100 cc., 3.75--9.25 mg. (4.00--7.60); calcium per hour, 0.58--3.05 mg. (0.53--3.10); inorganic phosphorus per 100 cc., 7.7--22.60 mg. (6.3--23.2); and inorganic phosphorus per hour, 1.27--4.69 mg. (1.05--7.42). The author emphasizes the absence of any relationship between salivary calcium and phosphorus values and dental decay.

Becks, H., and W. W. Wainwright, 1942. HUMAN SALIVA. XII. THE EFFECT OF FLAVORED ACTIVATORS ON SALIVA FLOW AND CALCIUM AND PHOSPHORUS COMPOSITION. *Jour. dent. Res.*, 21 (1): 87-97.

The effect of chewing flavored and unflavored activators (paraffin, chicle, and gums of various flavors) upon salivary flow was tested on 4 individuals (2 males and 2 females). Calcium and phosphorus determinations were also made.

The flow of resting saliva averaged 11.4 cc./hr. After chewing 1 g. paraffin, an average increase in flow of 961.5% occurred during the first period of activation (450 chews), decreasing to 895.8% and 767.3% in the second and third periods (450 chews each). Individual records are presented.

The average Ca values decreased 32.4%, 40.1% and 45.9% during the first, second, and third periods of activation, respectively; the decrease in inorganic phosphorus averaged 39.7%, 48.3%, and 46.3%. An inverse correlation is thereby seen between the values for Ca and P and the flow of saliva.

When subjects were given chicle to chew, the salivary flow increased 412.0% during the first period, but decreased to 275.0% and 232.4% (of the resting flow) during the second and third periods.

During the first, second, and third periods, the Ca values decreased 24.6%, 12.2% and 21.4%, respectively; the P decreased 26.0%, 26.1%, and 21.0%, respectively.

The values for Ca and P in mg./hr. during chicle activation were less than half of those for paraffin (values are given in table I).

The author attributes the variations in the composition and flow of paraffin-stimulated and chicle-stimulated salivas to the physical consistency of the substance chewed, since both are unflavored.

Three series of tests were made using various flavored gums as activators. An increase in salivary flow was observed in all 3 tests. For the first flavored activator, an increase of 924.2%, 440.6%, and 332.0% respectively, occurred in periods one through three; for the second, 974.0, 360.6, and 352.2%, respectively; and for the third, 1,324.9%, 586.5, and 381.7%, respectively.

In contrast to the effects of the unflavored activators, 2 of the 3 flavored gums produced a remarkable increase in Ca in the first period (14.7 and 8.4%); the third activator produced an increase of 1.3%. During the third period of activation, the Ca values decreased 17.3, 17.1, and 22.6% in the three experiments. The P values for the first activator decreased 36.6%, 38.0%, and 34.8% during periods one through three; for the second activator, 26.3%, 43.6%, and 30.3%; and for the third activator gum, 41.1%, 43.1%, and 38.6%, respectively.

The increase in salivary Ca occurring with flavored activators is attributed to an elective response of the salivary glands to the flavors; the accompanying decrease in P may possibly be attributed to activation by different nerves, to changes within the granules of the individual salivary cells, or to a response of different cells within the same or within different salivary glands.

Becks, Herman, 1942a. SALIVARY AND BACTERIOLOGICAL CONSIDERATIONS IN THE CONTROL OF DENTAL CARIES. *Jour. Amer. Coll. Dent.*, 9 (2): 184-190.

A study was made of the relationship between salivary calcium and phosphorus, nutritional state, oral bacteria, and dental caries. Determinations obtained from 198 caries-immune and caries-susceptible college students revealed that there was no significant relationship between the rate of salivation, salivary calcium and phosphorus, and caries count. However, a definite correlation was found to exist between the *Lactobacillus acidophilus* index (Bunting and Jay) and the presence or absence of caries. Of 90 caries-immune students, 95% were found to have negative bacterial counts, while 86% of 109 caries-active individuals showed a high incidence of *Lactobacillus acidophilus*.

Further experiments were performed on three groups of 122 persons each, which confirmed the fact that *L. acidophilus* exists in high counts in those persons with active caries.

Nutritional determinations revealed that the ingestion of proteins, calcium, phosphorus, carotene, thiamin, ascorbic acid, and vitamin D

had no influence on the incidence of caries. However, a greater refined-sugar intake (along with a high lactobacillus count) was rather characteristic of those persons suffering from dental caries. It was indicated that the *L. Acidophilus* count could be reduced by reducing sugar consumption.

Becks, H., and W. W. Wainwright, 1943. HUMAN SALIVA. XIII. RATE OF FLOW OF RESTING SALIVA OF HEALTHY INDIVIDUALS. Jour. dent. Res., 22 (5): 391-396. Abst: Jour. dent. Res., 22 (3): 216.

The rate of flow of resting saliva of 661 healthy individuals (5 to 95 years of age) was studied over a three-year period. The arithmetic mean of flow was 19 ± 0.54 cc./hr. (S. D. = 14 ± 0.38 cc./hr.); the individual values ranged from 0.5 to 111.0 cc./hr.

A possible correlation between age and rate of salivary flow was studied. 484 individuals, ranging in age from 5 to 49, were selected (the number of healthy persons over 49 being limited) and were separated into five-year groups. The total arithmetic mean of flow was 19 ± 0.63 cc./hr., and the S. D. = 14 ± 0.45 cc./hr. Significant differences occurred in the 5 to 9 year group (15 ± 1.25 ; S. D. = 9 ± 0.88) and the 10 to 14 year group (19 ± 1.33 ; S. D. = 15 ± 0.94); the means for the remaining groups plateaued.

No significant differences according to sex were noticed. The average age for the males (235) was 23 ± 0.74 ; for the females (249), 22 ± 0.82 years. The flow rates were 20 ± 0.81 cc./hr., and 19 ± 0.96 cc./hr., respectively.

Becks, H., 1943a. HUMAN SALIVA. XIV. Total calcium content of resting saliva of 650 healthy individuals. Jour. dent. Res., 22 (5): 397-402. Abst: Jour. dent. Res., 22 (3): 216.

The total calcium content of the resting saliva of 650 individuals was studied. The arithmetic mean was 5.8 ± 0.05 mg./100 cc. (S. D. = 1.4 ± 0.04 mg./100 cc.); the individual values ranged from 2.4 to 11.3 mg./100 cc.

The relationship between age and rate of salivary flow was studied. In 484 persons, selected and divided by age as previously [cf. Becks, 1943m], the arithmetic mean was 5.7 ± 0.06 mg./100 cc. (S. D. = 1.2 ± 0.04 mg./100 cc.). The difference between the means of the 10 to 14 and the 15 to 19 age groups was significant; after 19, the means showed a less significant increase. The average of the eliminated group (50 to 95 years) was 6.1 ± 0.14 mg./100 cc. (S. D. = 1.7 ± 0.10 mg./100 cc.), indicating an increase of calcium content with age.

When calcium content was correlated with sex, the males (235) had a slightly higher calcium content than the females (249); the average values were 5.9 ± 0.09 mg./100 cc., and 5.6 ± 0.07 mg./100 cc., respectively.

The total calcium secretion in the 650 individuals averaged 1.06 ± 0.03 mg./hr. (S. D. = 0.80 ± 0.02) with a range of 0.12 to 6.29 mg./hr. In general, no correlation was observed between age and calcium content; in the 5-9 year group, however, the average was lower than for any other group. The S. D. of the mg./100 cc. values for the 5-34 year olds were all greater with respect to the range than were the mg./hr. values. No significant difference occurred between the mean for the males (1.15 ± 0.05 mg./hr.) and that for the females (1.00 ± 0.06 mg./hr.).

Becks, Hermann, and W. W. Wainwright, 1943b. RATE OF FLOW OF RESTING SALIVA OF HEALTHY INDIVIDUALS. Hermann Becks. XIV. TOTAL CALCIUM CONTENT OF RESTING SALIVA OF 650 HEALTHY INDIVIDUALS. W. W. Wainwright. XV. INORGANIC PHOSPHORUS CONTENT OF RESTING SALIVA OF 650 HEALTHY INDIVIDUALS. Jour. dent. Res., 22 (3): 216.

Abstracts of all three papers are combined in one abstract:

"For an analysis of the extent of variations of salivary rate of flow, mixed human saliva was obtained from 650 different healthy individuals between the ages of 5 to 95 years. The average rate of flow of 650 individuals was 19 ± 0.54 cc./hr. ($M \pm \sigma_m$, the standard deviation was 14 ± 0.38 cc./hr. ($\sigma \pm \sigma_o$), with a total range from 1 to 111 cc./hr. Analyses for total calcium content of mixed human resting saliva of the same 650 individuals revealed: Total calcium mg. %: Male, female, and total groups showed a slow rise in the average means of 5 year age groups, reaching a maximum in the 25 to 29 year group, followed by a plateauing. The correlation coefficient of the entire group ($r = +0.230 \pm 0.037$) was smaller than that of the younger individuals aged 5-29 years ($r = +0.387 \pm 0.019$). Due to the lack of definite ranges for specific age groups and the large overlapping of ranges, it is impossible to set up a normal standard for any specific age group or for the total group, and only an apparent normal range can be given for the 650 healthy individuals with a mean of 5.8 ± 0.06 mg.% and a standard deviation of 1.4 ± 0.04 mg.%. The total range of values observed was from 2.2 to 11.3 mg.%. Total Calcium mg./hr. The lack of relationship between total calcium mg./hr. values and age of individuals is reflected in the zero correlation coefficient ($r = \text{of} + 0.003 \pm 0.039$). In the younger individuals from 5 to 29 years the r of $+0.380 \pm 0.050$ was significant though slight, indicating the tendency for low calcium mg./hr. values to be found in low age groups. The results from 650 individuals gave a mean of 1.06 ± 0.03 mg./hr. and a standard deviation of 0.80 ± 0.02 mg./hr. with a total observed range from 0.12 to 6.28 mg./hr. Inorganic phosphorus analyses of mixed resting saliva of 650 healthy individuals, aged 5 to 95 years, showed: Inorganic Phosphorus mg. %: Averages of male and female groups by 5 year intervals increased progressively up to 50 years. The correlation between phosphorus mg.% and age was greater for the entire group of 650, r being $+0.344 \pm 0.034$, than for the individuals from 5 to 29 years whose r was $+0.189 \pm 0.051$. The averages for 650 individuals are mean = 16.8 ± 0.25 mg.%. Inorganic Phosphorus mg./hr.: The lowest average mg./hr. value is again found at 5 to 9 years. The averages of older groups do not differ significantly from each other. The wide range of results is reflected in the lack of correlation between phosphorus mg./hr. and age in the entire group ($r = +0.125 \pm 0.038$). The mean of all inorganic phosphorus mg./hr. values is 3.1 ± 0.07 mg./hr., the standard deviation is 1.9 ± 0.05 and the total observed range is from 0.2 to 16.7 mg./hr." (Complete paper.)

Becks, Hermann, and W. W. Wainwright, and D. H. Young, 1943c. FURTHER STUDIES OF THE CALCIUM AND PHOSPHORUS CONTENT OF RESTING AND ACTIVATED SALIVA OF CARIES-FREE AND CARIES-ACTIVE INDIVIDUALS. Jour. dent. Res., 22 (2): 139-146.

The total salivary calcium and inorganic phosphorus of 50 individuals (25 caries-free and 25 caries-active) were determined in both resting and activated saliva samples obtained 1 to 3 hours after breakfast. The method of Karshan (cf. Karshan, 1931n) was employed.

The arithmetic means of all calcium and phosphorus mg./100 cc. and mg./hr. values of all salivas fell within the same ranges and differences were not statistically significant. In resting saliva, the mean rates of saliva flow of the caries-free and caries-active groups differed by only 0.52 cc./hr.; the arithmetic means of calcium, by only 0.24 mg./100 cc. (0.007 mg./hr.), and those of phosphorus, by only 2.14 mg./100 cc. (0.48 mg./hr.). For activated saliva, the values were 2.71 cc./hr., .55 mg./100 cc. (.20 mg./hr.), and .23 mg./100 cc. (.63 mg./hr.), respectively.

Becks, Hermann, and W. W. Wainwright, 1944. HUMAN SALIVA. XVIII. RELATIONSHIP OF TOTAL CALCIUM AND INORGANIC PHOSPHORUS TO RATE OF FLOW OF RESTING SALIVA. Jour. dent. Res., 23 (3): 212.

"The mg. % calcium content of 650 individuals tended to relate inversely to the rate of flow ($r = -0.156 \pm 0.038$). The lowest rates of flow were accompanied by the highest mg. % calcium values, while above 19 cc./hr. the calcium content remained level. The phosphorus content showed a slight inverse relationship to rate of flow ($r = -0.281 \pm 0.034$). The correlation coefficients of all relationships between mg./hr. values (calcium or phosphorus or their ratio or product) and cc./hr. were extremely high; for example: total calcium mg./hr. and rate of flow, $r = +0.913 \pm 0.006$; inorganic phosphorus mg./hr. and rate of flow, $r = +0.810 \pm 0.013$; calcium-phosphorus product mg./hr. and rate of flow, $r = +0.770 \pm 0.016$; calcium mg./hr. and phosphorus mg./r. $= +0.783 \pm 0.016$. These high correlations resulted because of the relatively slight relation between mg. % concentration and rate of flow and the fact that the amount per time unit (mg./hr.) was greatly influenced by the amount of saliva produced (cc./hr.). The high correlation between calcium and phosphorus mg./hr. values was not due to any high correlation between the minerals but rather to the manner of calculating the mg./hr. value. This was confirmed by an exceedingly low partial correlation coefficient of calcium mg./hr. and phosphorus mg./hr. holding rate of flow constant ($r_{12.3} = +0.154 \pm 0.038$). The calcium-phosphorus ratio was related slightly to rate of flow ($r = +0.237 \pm 0.037$). The calcium-phosphorus mg. % product reflected the relationships of these constituents to rate of flow ($r = +0.223 \pm 0.037$)." (Complete paper.)

Becks, H., and W. W. Wainwright, 1946. HUMAN SALIVA. XVI. RELATIONSHIP OF TOTAL CALCIUM TO INORGANIC PHOSPHORUS OF RESTING SALIVA. Jour. dent. Res., 25 (4): 267-274.

The relationship of total calcium to inorganic phosphorus of resting saliva was studied in 650 individuals between 5 and 95 years of age.

Individual ratios of calcium to phosphorus per 100 cc. saliva ranged from 0.12 to 1.22, averaging 0.36 (S. D. = 0.12). For the entire group, the products of total calcium and inorganic phosphorus (expressed in mg./100 cc.) ranged from 27.2 to 681.6. A comparison of the averages and

standard deviation of 5-year groups was not feasible because of the large skewness value.

When correlated with the age of the individual, the highest Ca/P ratios occurred between 20 and 29 years of age, and the lowest in younger and older groups. Apparently, both the salivary calcium and inorganic phosphorus increase with age in the child; the calcium content, however, increases more rapidly. Between the ages of 20 and 29, the calcium-phosphorus ratio is at its peak and the calcium concentration, at its highest. Thereafter, the phosphorus content rises, while the calcium does not increase noticeably.

Individual variation in products of calcium and phosphorus ranged from 0.07 to 77.25. Again it was not feasible to calculate the averages and the standard deviation because of the extreme asymmetry. No differences between the 5-year groups were indicated.

Adv. abst.: Jour. dental Res., 23 (3): 211-212. 1944.

Becks, H., and W. W. Wainwright, 1946a. HUMAN SALIVA. XVII. RELATIONSHIP OF TOTAL CALCIUM AND INORGANIC PHOSPHORUS TO RATE OF FLOW OF RESTING SALIVA. Jour. dent. Res., 25 (4): 275-283.

"The relationships of total calcium and inorganic phosphorus content to rate of flow of resting saliva were examined in 650 healthy individuals and are summarized as follows:

"1. The calcium content (mg.%) tended to be related inversely to rate of flow, however, with a low correlation coefficient, $r = -0.156 \pm 0.038$. The lowest rates of flow were accompanied by the highest mg.% calcium values, while above 19 cc./hr. the calcium content plateaued.

"2. Similarly, the phosphorus content (mg.%) showed a slight inverse relationship to rate of flow ($r = -0.281 \pm 0.034$).

"3. The correlation coefficients of all relationships between mg./hr. values (calcium or phosphorus or their ratio or products) and cc./hr. were extremely high; for example: total calcium mg./hr. and the rate of flow $r = +0.913 \pm 0.006$; inorganic phosphorus mg./hr. and rate of flow, $r = +0.810 \pm 0.013$; calcium-phosphorus product mg./hr. and rate of flow, $r = +0.770 \pm 0.016$; calcium mg./hr. and phosphorus mg./hr., $r = +0.783 \pm 0.016$. These high correlations result only because of the relatively slight relation between mg.% concentration and rate of flow and the fact that the amount per time unit (mg./hr.) is greatly influenced by the amount of saliva produced (cc./hr.). That is, the values of mg./hr. are dependent on the cc./hr., as might be expected since both are expressions of quantity. This conclusion, that the high correlation between calcium and phosphorus mg./hr. values is not due to a high correlation between the minerals but is due to the manner of calculating the mg./hr. value, was confirmed in the finding that the partial correlation coefficient of calcium mg./hr. and phosphorus mg./hr. holding rate of flow constant was exceedingly low, $r_{12.3} = +0.154 \pm 0.038$.

"4. The calcium-phosphorus ratio (which is numerically the same for mg.% and mg./hr. values) was related slightly to rate of flow; $r = +0.237 \pm 0.037$ indicating that the lower the rate of flow, the higher will be the calcium-phosphorus ratio.

"5. The calcium-phosphorus product mg.% reflected the relationships of these constituents (considered separately) to rate of flow; r was very low, -0.223 ± 0.037 ." (Author's summary and conclusions.)

Beebe, Richard T., 1936. XEROSTOMIA. *Internat. Clin.*, 4 (ser. 46): 86-94.

A case history of a 47 year-old woman is presented in which the diagnosis of xerostomia was made, and which was unusually attended by chronic anemia, bilateral parotitis, aptyalism, and histamine achlorhydria. The symptoms, physical findings, treatment methods, etiology, and prognosis of dry mouth are discussed in general, as well as previous studies which are pertinent to the condition.

Beebe, S. P., 1902. A NOTE ON THE INFLUENCE OF HEAT ON ENZYMES. *Amer. Jour. Physiol.*, 7 (3): 295-300.

A study was made of the influence of various temperatures on the ability of invertin, diastase, and saliva to reduce a standard copper solution. A filtered sample of mixed human saliva was used, diluted ten times, and heated for 10 and 25 minutes at 43°C . A temperature of 40°C produced no marked changes in the activity of either enzyme.

Beerstecher, Ernest, Jr., and Sarah Altgelt, 1951. APOERYTHEIN IN SALIVA. *Jour. biol. Chem.*, 189 (1): 31-34.

Determinations of the apoerythein content of the salivas of 20 healthy subjects showed the salivary concentration to average 55.5 milliunits/ml. with a mode of 49.0 milliunits. Individual salivary concentration averages of 11 subjects varied from 31 to 73 milliunits. Apoerythein concentrations tended to decrease immediately before meals, and to show a further drop immediately after eating. Tests showed salivary dilution not to be the sole cause of the decreased concentration; the decrease suggested the possibility of a limited apoerythein reserve available for excretion during increased salivary secretion.

Beerstecher, Ernest, Jr., and Eleanor J. Edmonds, 1951a. APOERYTHEIN STUDIES. IV. NON-IDENTITY OF SALIVARY, GASTRIC JUICE, AND GASTRIC MUCOSAL APOERYTHEIN ACTIVITIES. *Proc. Soc. exper. Biol. Med.*, 77 (3): 563-565.

Salivary apoerythein was distinguishable from that of other body sources studied by its thermal behavior; its activity was destroyed at 70°C ., but not at temperatures between 75° and 100°C ., nor below 65°C ., whereas apoerythein of gastric juice origin was destroyed at temperatures of 70°C . to 100°C . and that of gastric mucosa was not notably affected by any temperature up to 100°C .

Beerstecher, Ernest, Jr., and Eleanor J. Edmonds, 1951b. ANOMALOUS THERMAL BEHAVIOR OF SALIVARY APOERYTHEIN ACTIVITY. *Science*, 114 (2964): 412.

Studies on the thermal stability of salivary apoerythein show complete loss of its activity to result from heating saliva to 70°C for periods of one minute or more. The peak inactivation temperature is slightly above 70° ; some inactivation occurs between 65° and 75° . Samples heated to temperatures below 65° or between 75° and 100°C show no measurable loss of activity. Samples

first heated to over- 70° temperatures and then heated at 70° showed no loss of activity. The over- 70° thermal treatment apparently affects salivary apoerythein activity as such treatment renders the activity immune to destruction at 70° for even prolonged periods.

Behrman, Howard R., and K. K. Lee, 1950. SJÖGREN'S SYNDROME. *Arch. Dermatol. Syph.*, 61 (1): 63-79.

The case history is presented of a Sjogren's syndromic 61-year-old woman with a previous history of fibroma of the cervix, arthritis, and Raynaud's phenomenon. The subject gave the following signs and symptoms: xerostomia, burning of the tongue and angles of the mouth, a dry tongue, dryness and superficial inflammation of the buccal mucosa and uvula, and failure of either parotid gland to produce saliva after the injection of 8 mg. of pilocarpine. Treatment produced no apparent improvement.

A discussion is also presented of the literature concerning the historical accounts, etiology, symptomatology, pathology, and treatment of Sjögren's syndrome.

Bekhterev, V., and N. Mislavskii, 1888. O VLIYANIÍ MOZGOVOÍ KORY NA OTDELENIE SLIŬNY [On the influence of the brain cortex on salivary secretion]. *Med. Obozrenie*, 30 (13): 52-54.

The influence of the cerebral cortex on salivary secretion was studied in curarized and trephined dogs having a cannulated submaxillary duct and, in some dogs, a cannulated parotid duct. Very weak faradic stimulation of the fourth primary circonvolution region, situated anterior and above the fissure of Sylvius, elicited submaxillary salivation. A lesser salivary affect was produced by a somewhat stronger stimulation of either the whole frontal portion of the sigmoid circonvolution or the exterior portion of its posterior part, or the frontal parts of the second and third primary circonvolution. Only submaxillary saliva was stimulated. Stimulation of the frontal lobes, or of the parietal, temporal and occipital lobes of the posterior induced no salivation although existing submaxillary salivation was occasionally increased tardily after stronger stimulation of the posterior parts. Secretion was usually greater ipsilateral to stimulation; the saliva was always thin, corresponding to chordal salivation. Resection of the chorda tympani stopped secretion on the operated side; resection of the sympathetic nerve had no apparent effect; sympathetic stimulations in dogs elicits only a small amount of secretion.

Belding, P. H., and L. J. Belding, 1937. A PRELIMINARY REPORT ANNOUNCING THE DISCOVERY OF AN ADDITIONAL LINK IN THE ETIOLOGIC CHAIN OF DENTAL CARIES. *Dent. Items of Interest*, 59 (12): 1137-1139.

A preliminary report is made of the study of the saliva of 600 caries-susceptible and caries-immune persons and of the influence of this saliva when inoculated into sugars, cereals, and other foods. The saliva of caries-susceptible individuals was found to ferment the cereals much more rapidly than the caries-immune; little difference was noted in the ability to ferment sugars.

A study of the salivary bacteria associated with these fermentation reactions showed both rods and streptococci to be present; streptococci are believed to be the organisms chiefly concerned in the fermentation of cereals.

Belding, P. H., and L. J. Belding, 1938. DENTAL CARIES. *Dent. Items of Interest*, 60 (5): 412-422.

A study was made of the influence of diet on the etiology of dental caries and of the characteristics of oral aciduric bacteria and their cultural reactions in the foods of civilized men. Studies done on the saliva of 20 caries-immune and 20 caries-susceptible males indicated that the reactions of the saliva of both groups were identical on entry into the mouth and that local conditions in the mouth led to a depletion of the salivary alkaline reserve in the caries-susceptible cases. It is concluded, therefore, that acid formation must be different in the 2 groups.

Saliva specimens from over 1000 individuals were incubated at body temperature for 4 hours in liquid media of several sugars, cereals, and other foods and the presence of fermentation and the degree of acid formation were determined by the addition of a few drops of Universal Indicator. Cereals were fermented extremely rapidly and produced large amounts of acid; starch rice, cane sugar, etc. showed very slow fermentation and produced a small amount of acid; dextrose and lactose were fermented at a moderate rate and produced moderate amounts of acid. The most significant difference between the fermentation ability of caries-susceptible and caries-immune cases was the speed of fermentation rather than the amount of acid formed.

Streptococci were found to be the first organisms encountered in fermentation reactions; after 48 to 72 hours, bacilli of the genus *Pseudomonas* began to increase in numbers; other organisms were found infrequently and inconstantly. The streptococci are believed to be chiefly concerned in fermentation reactions.

Belding, P. H., and L. J. Belding, 1940. DIET, BACTERIA, AND DISEASE. Part I. *Dent. Items of Interest*, 62 (4): 303-314.

A study of 40 humans subsisting on identical diets, in identical environments, and with similar salivary acid combining powers, indicated that some individuals are more susceptible to dental caries than others, and that salivary acidity varies among different subjects. A continuation of the above study, using 600 human subjects, revealed that different salivary samples vary (2-24 hours) in ability to induce fermentation and to cause the formation of acids. However, the same amount of acid, generally, is produced by all individuals within 72 hours.

A series of experiments revealed that the speed with which saliva ferments various substances to produce acid is related to dental caries, the faster fermentation rate being related to the greater number of dental caries. There are marked differences in the ability of identical amounts of individual salivary samples to produce a given amount of acid in different media. In vitro studies demonstrated that many foods, used as staples of primitive diets, tend to delay salivary fermentation processes, as

well as inhibit bacterial growth. Cereals, on the other hand, were found to promote the fermentation processes of acidogenic bacteria.

Streptococcus odontolyticus was observed to be the most abundant species of bacteria present during the first 24 hours of the fermentation process. It is commonly found in salivary samples of civilized persons on cereal and refined diets, rapidly initiates fermentation, and causes the production of a large amount of acid.

It is concluded that this difference in fermentative ability of oral bacteria in different media may be responsible for the greater number of dental caries in the mouths of civilized persons than in those consuming a more primitive diet which does not greatly potentiate the production of a dental caries causative factor (acids).

Belding, P. H., and L. J. Belding, 1940a. ALTERATIONS IN THE MORPHOLOGY AND THE REACTION CAPACITY OF *STREPTOCOCCUS SALIVARIUS*. Part II. *Dental Items of Interest*, 62 (5): 423-445.

In vitro studies of salivary bacteria, *Streptococcus salivarius*, obtained from human adults, dogs, cats, cows, calves, mice, and breast-fed babies, indicate that certain changes occur in an animal's oral flora when it is introduced to modern or refined foods; that there are detectable differences in the salivary acids produced by the oral bacteria of various animals.

Samples of breast-fed infant's saliva were found to contain bacteria which produce little acid and show little or no tendency to mutate, while the oral flora, recovered from the saliva of human adults or refined-food-fed babies, showed a high acid-producing ability as well as a great tendency toward mutating into high acid-generating forms.

Cultures were grown on a number of media, e.g., agar sucrose blood plates, milk, soy bean, potato, wheat, carrots, rutabaga, etc., and culture examinations demonstrated that oral bacterial flora may become conditioned to a new environment, and could undergo morphological and metabolic changes in a foreign medium.

Based on evidence from this series of experiments, it appears that a predisposition to dental caries is made possible by the introduction of animals to certain carbohydrate diets, and other refined or "civilized" foods, i.e., caries acuta occurs only after such an introduction.

Belding, P. H., and L. J. Belding, 1941. NEW LIGHT ON DENTAL CARIES OR THE INFLUENCE OF THE MODERN DIET ON BACTERIAL EVOLUTION. *Jour. Amer. dent. Assoc.*, 28 (10): 1645-1656.

An extensive review, essentially of the etiology and treatment of dental caries, but also including specific discussions on the anti-bacterial agents in saliva. 47 refs.

Belding, P. H., and L. J. Belding, 1944. MUTATIONS OF BACTERIA UNDER DIETARY INFLUENCE. *Jour. dent. Res.*, 23 (5): 375-378.

The oral floras of primitive peoples of the earth, and of dogs, cats, breast-fed babies, etc., are characterized by the lack of pathogenic organisms. In the babies, the absence of acid-producing organisms and of streptococci in the mucoid state is likewise noticed.

When breast-fed babies are placed on a diet containing sucrose and cereal, the oral flora begins to take on the adult characteristics of complexity, pathogens become frequent, and streptococci are transformed to the mucoid state. If a 1% sucrose plate is streaked with saliva of such a baby, mucoid colonies are produced by the majority of streptococci.

These changes in the oral flora of an infant can be reproduced *in vitro*, on media containing sucrose and cereal. In test tubes, the development of the mucoid state is favored on crude and refined cereals, while only refined products have much significance in the maintenance of this mucoid state in saliva. Refined cereal products (in contrast to the whole-grain products) do not sustain antibiosis and, therefore, permit selective growth of acidogenic streptococci.

Mucoid "mutational" forms of *Streptococcus salivarius* may be induced by sucrose and are sustained by refined cereals. When these forms are grown in the presence of potato sucrose, the organisms revert to their primitive level.

The author attributes caries formation to a shift of the primitive flora to the acidogenic state and to a conversion of oral streptococci from a smooth vegetative to a mucoid phase, after the condition of caries hypersusceptibility has been established. In this case, practically all carbohydrates consumed by man can be converted into acid with great rapidity.

Belding, P. H., and L. J. Belding, 1948. SALIVARY INHIBITION AND DENTAL CARIES. *Jour. dent. Res.*, 27 (4): 480-485.

A review of literature data on the significance of salivary inhibition in the occurrence of dental caries led to author to conclude that:

"1. Under natural conditions, the body has a mechanism which eliminates transforms, or kills many types of pathogenic organisms.

"2. Within recent years, civilized human beings have encountered an environmental factor which makes caries acuta an almost universal disease and concomitantly reduces the effectiveness of the bactericidal and bacteriostatic mechanism of the saliva.

"3. Sucrose, because of its inhibitory action on bacteria and the resultant mutations, is probably the most important environmental factor which had interfered with functioning of the oral autarctic immunity mechanism.

"4. It is suggested that the high incidence of scarlet fever, diphtheria, dental caries, appendicitis, and other diseases of civilized man might be partially explained by the difference, bacteriologically, which exists between modern and primitive communities." (From the authors' summary.)

The authors suggest a diet which is supposed to revert mucus-producing oral streptococci to the primitive level and to inactivate the caries-producing factors in saliva.

Belikov, P. F., and Z. V. Astrakhanskaiâ, 1929. O LITICHESKOM FAKTORE SLIŬNY [On the lytic factor of saliva]. *Odontol. Stomatol.*, 7 (1): 26-29.

Study was made of the presence and biological properties of salivary lysozyme in subjects with healthy oral mucosa or with pyorrhea and other diseases. Salivary samples at dilutions from 1:5 to 1:5120 were seeded to cloudiness with one or

two loops of an agar culture of a sarcina or of a large staphylococcus and the mixture incubated either at 37°C, or in a water bath at 56°C, for 3 hours. Lysozyme activity was noted rarely at dilutions of 1:5, usually at 1:10 to 1:80, occasionally at 1:640. Activity was not noted regularly from one dilution to the next, being observed on occasion at 1:40 and at 1:160 but not at 1:80. Salivary lysozyme was not constant in presence in the same subject from day to day; it was found almost as frequently in healthy subjects as in diseased subjects, being noted in 43 of the 100 tests in healthy subjects and in 47% of 60 patients with pyorrhea, gingivitis, or stomatitis. No relationship could be detected between its presence and the course of the disease. No special importance is thus attributed to lysozyme action in the bacterial purification of the mouth during various diseases, although it does contribute to general bacterial purification. An investigation of the origin of the salivary lysozyme showed salivary sediment to have a stronger lytic action on test organisms, being noted at higher dilutions than the supernatant fluid; this suggests the source to be the salivary corpuscles, which are polynuclear leukocytes according to Grosse and Kurpnikova (1927). An attempt to verify this assumption did not succeed. The relationship between salivary and the egg-white lysozymes was investigated in another series of experiments. A rabbit, whose blood-serum had shown absence of lysozyme, was immunized during several weeks with an emulsion of chicken egg-white; the animal's immunized serum then produced a marked precipitation (up to 1:100) with the chicken egg-white emulsion. Addition of the immunized serum to the egg-white dilutions in the presence of microbial culture completely blocked the lysis, while the control serum produced it normally. This bacteriolytic test was repeated with saliva, producing the same results. Thus, the antibody contained in the immunized rabbit serum, which deactivated the lytic factor of the chicken egg-white, also deactivated the lysozyme action of saliva, indicating a uniform nature of lysozymes of different origin. Further study is in progress.

Bell, E. John, 1948. THE RELATIONSHIP BETWEEN THE ANTIPOLIOMYELITIC PROPERTIES OF HUMAN NASOPHARYNGEAL SECRETIONS AND BLOOD SERUMS. *Amer. Jour. Hyg.*, 47 (3): 351-369.

The salivas of 25 persons were examined for their capacity to neutralize the poliomyelitis virus (Lansing strain); method is fully described. Those of four persons neutralized the strain; each of these persons had serum antibodies for the Lansing strain, 3 being relatively high, and had neutralizing antibodies in their nasopharyngeal secretions. The saliva of a fifth person, also having a high level of serum and nasopharyngeal antibodies, failed to neutralize the virus. The antibody in the positive saliva samples was of low titre; a 1-10 dilution failed to neutralize the virus. No relationship between the neutralizing capacities of the serum and of the saliva could be established.

Bellis, C. J., W. Bernheim, and F. H. Scott, 1932. EFFECT OF SALIVA ON COAGULATION OF BLOOD. *Proc. Soc. exper. Biol. Med.*, 29 (9): 1107-1108.

Paraffin-stimulated salivary samples were collected from test persons and centrifuged for thirty minutes. Blood, from the cannulated femoral artery of dogs, was collected into tubes containing a known amount of saliva. Four to eight samples were used for each determination and the coagulation times were averaged.

It was seen that the addition of saliva decreased the coagulation time of blood by a maximum of 80%. A definite decrease in coagulation time was seen when saliva was added to blood in proportions 1:400; the coagulation time was only slightly reduced when the proportion of saliva to blood was very great (20:1).

The coagulative power of saliva is relatively unaffected by heating at 60°C.; boiling reduces the power considerably but does not entirely destroy it.

When saliva alone is added to oxalate blood, large volumes (equal to or twice the volumes of blood) are required to induce some coagulation. The author attributes the coagulation to calcium in the saliva rather than to thrombin; no coagulation occurs when saliva is oxylated before mixing with the blood.

Bellis, Carroll J., and F. H. Scott, 1933. SALIVA AND COAGULATION OF BLOOD. *Proc. Soc. exper. Biol. Med.*, 30 (9): 1373-1375.

Investigations were made to determine the specificity of the coagulative properties of saliva.

Dog and bovine saliva were found to hasten the coagulation of dog, bovine, and human blood. A 25% time reduction occurred when 1 cc. of bovine saliva was added to 3 cc. of plasma (from 6'15" to 4'40"). The coagulant is non-specific in regard to source of saliva or blood; one manifestation is in a hemophilic's blood, which can be clotted by the addition of small amounts of saliva--the patient's own or that of a normal individual. The addition of one part saliva to four parts of blood reduced the clotting time of one individual from over two hours to three minutes. When the same volumes were used, but the saliva was diluted 1:100 with 0.9% NaCl, clotting time was reduced to 7 minutes.

The intravenous injection of 5 cc. of human saliva into an etherized dog produced a fall in blood pressure with accompanying hyperpnea; these effects disappeared quickly. The coagulation time of the animal's blood was increased rather than decreased. Similarly, subcutaneous injection of large quantities of saliva (200 cc.) in the dog delayed coagulation. Comparable coagulative properties were exhibited by fluid obtained from abdominal or intrathecal paracentesis.

Belote, George H., 1927. A SIMPLE COLOR TEST FOR BROMINE IN BODY FLUIDS. *Jour. Amer. med. Assoc.*, 88 (22): 1696-1697.

A simple specific test is described for the detection of bromine in saliva and other body fluids.

Benard, Henri, and Ernest Schulmann, 1918. LES VARIATIONS DE POTENTIEL ELECTRIQUE AU COURS DU FONCTIONNEMENT DES GLANDES: LA METHODE GALVANOMETRIQUE COMME MOYEN D'ETUDE DU TRAVAIL GLANDULAIRE [Variations of electrical potential in the course of glandular function: the galvanometric method as a means of studying glandular

function]. *Compt. rend. Soc. Biol. (Paris)*, 81 (7): 358-362.

Electrodes were placed in the submaxillary gland and on the neighboring fascia of dogs to measure changes in potential that occurred while the gland was at rest or actively secreting. The dogs were under chloral anesthesia with or without injections of atropine.

Electrical stimulation of the chorda produced abundant salivation and a drop in the electrical potential of the gland. This electrical response began shortly after the stimulus and reached its maximum either immediately or some seconds after the excitation, then returned rapidly to its initial value. Administration of atropine suppressed salivation and change in electrical potential.

The value of the deviation obtained in the experiments was not directly related to duration of excitation but appeared dependent on its intensity.

Bénard, Henri, A. Horn, A. Kaswin, and A. Seeman, 1949. ACTION DES CYANURES ALCALINS SUR LA GLYCOGENOLYSE PAR PHOSPHORYLATION ET PAR HYDROLYSE AMYLASIQUE [Action of alkaline cyanides on glycogenolysis by phosphorylation and by amylatic hydrolysis]. *Compt. rend. Soc. Biol. (Paris)*, 143 (1-2): 18-20.

A study was made of the effects of potassium cyanide on glycogenolysis produced by human salivary amylase and by phosphorylase. Human saliva (diluted, 1/50) was incubated at room temperature for 60 minutes with a 0.005 solution of glycogen, .03 M NaCl, and a .03 M mixture of phosphates at pH7. Addition of .01 M potassium cyanide to the solution had no effect on the amount of reducing sugar released at the end of 60 minutes.

Benarde, Melvin A., F. W. Fabian, S. Rosen, C. A. Hoppert, and H. R. Hunt, 1956. A METHOD FOR THE COLLECTION OF LARGE QUANTITIES OF RAT SALIVA. *Jour. dent. Res.*, 35 (2): 326-327.

Description is given of a multi-unit animal holder designed to allow quantity collection of rat saliva in the shortest time while maintaining the animals securely. Use of the container permitted collection of 2-5 ml. of saliva in 20 minutes from adult rats, anesthetized by intraperitoneal injection of 20-50 mg. of Nembutal/kg. prior to subcutaneous injection of 5 mg. pilocarpine/kg.

Bender, I. B., R. S. Pressman, and S. G. Tashman, 1953. EFFECT OF PARENTERAL ADMINISTRATION OF ANTIBIOTICS ON BACTERIAL POPULATION OF THE MOUTH. *Jour. dent. Res.*, 32 (1): 78-86.

A study was made of the effects of the parenteral administration of various antibiotics on the bacterial flora of the mouth. Varying amounts of penicillin, dihydrostreptomycin, and chloramphenicol were found present in the saliva. Single intramuscular injections of 400,000 units of penicillin and 1 gm. of dihydrostreptomycin separately produced no significant reduction in the bacterial population count one hour after injection. A single intravenous injection of 1 gm. of chloramphenicol reduced the aerobic population of the mouth about 40 percent and the anaerobic count about 30 percent in one-half hour. One hour after a single intramuscular injection of a mixture of 1 gm. of dihydrostreptomycin and

400,000 units of penicillin, the aerobic and anaerobic counts were each reduced about 65 percent. It is suggested that the effectiveness of this mixture is due to the additive and synergistic effects of penicillin and streptomycin.

Bender, I. B., R. S. Pressman, and S. G. Tashman, 1953a. STUDIES ON EXCRETION OF ANTIBIOTICS IN HUMAN SALIVA. I. PENICILLIN AND STREPTOMYCIN. Jour. Amer. dent. Assoc., 46 (2): 164-170.

The salivas of three groups of patients who had received intramuscular injections of antibiotics were examined for antibiotic content. One group received a single dose consisting of 1 g. dihydrostreptomycin and 400,000 units penicillin (100,000 crystalline sodium penicillin and 300,000 procaine penicillin); another group received 400,000 units of penicillin without the streptomycin; and a third group, receiving no antibiotic therapy, served as controls.

Paraffin-stimulated saliva samples (approximately 5 ml. each) were collected after 0.5, 1, 2, 4, 6, and 8 hours, and were examined for antibiotic content by microbial assay (based on the technic of Osgood and Graham, Amer. Jour. clin. Pathol., 17:93, 1947); the Oregon J strain of *Staphylococcus aureus* [*Micrococcus pyogenes* var. a.] was used for streptomycin testing and the FDA strain 209, for penicillin.

The peak of excretion for each antibiotic was attained after one hour. For the penicillin-streptomycin mixture, the average concentration in 31 patients was 0.029 units penicillin per ml. saliva and ranged from 0.0125 to 0.062 units. Although a considerable drop occurred after one hour, penicillin was still detectable after 6-8 hours.

An inverse relationship was observed between the rate of destruction of penicillin in an aqueous solution and its concentration (at a concentration of 0.062 units/ml., 50-55% of penicillin was destroyed within two hours). The rate of destruction in saliva, however, is no greater than in water, indicating that penicillin is not affected by penicillinase-producing organisms or other enzymic action.

Results were similar in patients receiving penicillin without streptomycin.

The levels of streptomycin excretion, in contrast to penicillin, were almost as high after 30 minutes as they were after one hour. At the peak, attained after one hour, the average was 2.9 units streptomycin per ml. saliva, with a range from 1.1 to 4.3. An approximate 40% drop occurred after the second hour.

When compared with blood studies, the rates of antibiotic disappearance were faster in saliva than in blood.

Bender, I. B., R. S. Pressman, and S. G. Tashman, 1953b. STUDIES ON EXCRETION OF ANTIBIOTICS IN HUMAN SALIVA. II. CHLORAMPHENICOL. Jour. dent. Res., 32 (2): 287-293.

Single intravenous injections of 1 gm. of chloramphenicol were administered to patients and the resultant levels in blood and in saliva were measured at intervals ranging from one-half hour to 24 hours. Dilution of chloramphenicol with 50 ml. of heated physiologic saline and injecting it slowly eliminated most of the ill effects of

the injection. The peak level of chloramphenicol was reached in the first half hour in both blood serum and saliva. By the end of the second hour, there was an approximate 50 percent drop in both levels; after eight hours detectable amounts of the drug were still present. At the end of 24 hours, no detectable amounts were found in saliva. No relationship was observed between the concentration of chloramphenicol in the blood and in the saliva of the same patient. It is suggested that concentration of the drug may be related to blood and saliva volume.

Bender, I. B., R. S. Pressman, and S. G. Tashman, 1953b. STUDIES ON EXCRETION OF ANTIBIOTICS IN HUMAN SALIVA. III. AUREOMYCIN. Jour. dent. Res., 32 (3): 435-439.

A study was conducted to measure the concentration of aureomycin in saliva at various intervals following intravenous administration; excretion of aureomycin in the saliva was noted after fifteen minutes. An average peak concentration of 0.116 micrograms per milliliter was noted at the end of one hour, and at the end of two hours the level had fallen 40 percent. At the end of the fourth hour the concentration indicated a secondary rise to 0.106 micrograms, thereafter dropping continuously until the sixteenth hour. No aureomycin could be detected at the end of 24 hours.

Benedict, A. L., 1900. PRACTICAL PHYSIOLOGY OF THE DIGESTIVE ORGANS. Jour. Amer. med. Assoc., 35 (4): 207-209.

Included in a discussion of the physiology of the digestive organs is a note on the value of saliva and of the salivary glands in digestion.

Benetato, Gr., and C. Oprisiu, 1938. SUR LES VARIATIONS DU pH ET DES BICARBONATES SALIVAIRES DANS DES ETATS D'ACIDOSE ET D'ALCALOSE PROVOQUES [On the variations of pH and of salivary bicarbonates in the states of induced acidosis and alkalosis]. Compt. rend. Soc. Biol. (Paris), 128: 113-116.

Study was made in the dog of the effects of induced acidosis and alkalosis on the pH of parotid saliva. Alkalosis was induced by intravenous injection of a 4 percent solution of bicarbonate in doses of 10 cc./kg.; acidosis was induced by administration of a 1.5 percent solution of ammonium chloride in doses of 7.5 cc./kg. In some studies use was also made of animals in which acidosis was induced by muscular effort. Saliva was collected under paraffin from a parotid fistula and the pH tested electrometrically.

The tabulated results show that acidosis is followed by a marked reduction of the salivary bicarbonate level and a drop in salivary pH; alkalosis produces the opposite effects, with a less marked change in concentration of salivary bicarbonate.

Benetato, Gr., and C. Oprisiu, 1938a. SUR L'ELIMINATION DE L'ACIDE LACTIQUE ET DE L'AMMONIAQUE PAR LA VOIE SALIVAIRE DANS LA ETAT D'ACIDOSE PROVOQUE [On the elimination of lactic acid and of ammonia via the saliva in the state of induced acidosis]. Compt. rend. Soc. Biol. (Paris), 128: 116-118.

A study was made of the concentrations of lactic acid and ammonia in the blood and parotid

saliva of the dog, before and immediately after muscular effort. A marked increase was noted in the amount of lactic acid in both saliva and blood after exercise. A small, inconstant increase was also found in the ammonia content of these fluids. The increase in the blood ammonia level was found to be raised to the same degree in both arterial and venous blood of the parotid gland. The salivary glands are considered to participate in maintenance of the acid-base equilibrium.

Bensley, Robert R., 1908. OBSERVATIONS ON THE SALIVARY GLANDS OF MAMMALS. *Anat. Rec.*, 2 (3): 105-107.

A study was made of the salivary glands of the cat, dog, rabbit, rat, gopher, and horse which permitted a classification of the serous class of cells into subordinate groups.

Bercher, J., and R. Sohler, 1939. UN APPAREIL SIMPLE POUR L'ASPIRATION DE LA SALIVE PAROTIDIENNE [A simple apparatus for the aspiration of parotid saliva]. *Rev. Stomatol. (Paris)*, 41 (8): 633-635.

A simple apparatus for the collection of parotid saliva is described in detail. The device consists of a rubber-stoppered, thick glass test tube, from which two glass tubes leave at right angles in opposite directions. One terminates in a small glass cup which is placed over the entrance to Stenson's duct; the other, to a piece of rubber tubing terminating in a rubber ball, by means of which suction is produced.

In this way, it was possible to collect 10-15 cm. of pure parotid saliva within 10 minutes.

Berenson, F. B., 1949. TSITOLOGIIÂ SLIŬNY I EE ZNACHENIE V KLINIKE STOMATITOV [The cytology of the saliva and its significance in the clinic of stomatitis]. *Stomatologiiâ (Moskva)*, 3: 18-21.

Preliminary study was made of the morphology of cytological elements and qualitative changes in the cytological content of saliva during inflammatory processes of the oral mucosa. The collection of material was done by means of mouth-rinsing with 0.85% sodium chloride (Iasinovskii's procedure, adapted). The cytological content of the saliva was determined 3 to 4 times for each patient; altogether over 200 slides were examined.

The cytological picture of the normal mucosa was first studied, and revealed slightly decomposing neutrophils, occasional leukocytes, microphages, epithelial cells and microflora (cocci, leptothrix, occasional spirochetes).

Study of 53 cases of mucous infection (mostly ulcerous) revealed besides blood cells, mesenchymal cells - histiocytes, emigrated polyblasts, Unna cells, as well as other transitory forms and microorganisms. A correlation was found between the intensification of the pathological development and the increase of cellular elements in the saliva: more phagocytic leukocytes appear in the saliva, and the number of reticular cells, histiocytes, polyblasts, etc., is increased. In weak reactions of the mucosa and dragging ulcerous stomatitis, many decomposing neutrophils are observed, occasional histiocytes, and Unna cells. The appearance of Unna cells indicates the reduction of phagocytosis by the reticulo-endothelial tissue. A description of two cases of mucous infection is given.

The author concludes that the cytological picture can serve to determine the reactive capacity of the mucosa in cases of infection, and be used in the clinical therapy and prognosis of stomatitis.

Berg, Arthur, 1929. UEBER DIE VERMINDERUNG DER SPEICHELSEKRETION DURCH MEDIKAMENTE [On the diminution of salivary secretion by medicaments]. *Zahnartzl. Rundschau*, 38 (42): 1727-1728.

The secondary effects of drugs commonly employed as inhibitors of salivary flow [i.e., Atropinum sulfuricum, Hyoscyaminum, Methylatropinum bromatum, Homatropinum hydrobromicum, and Scopolaminum hydrobromicum] are discussed with regard to their use in dentistry; those of Eumydrin are studied in detail. Oral or subcutaneous administration of Eumydrin produced the following effects: oral administration of 1-3 mg. increased salivary flow; 4 mg. apparently produced a weak effect manifested by dryness of the oral mucosa; 5 mg. produced a slight decrease, but salivary flow was still too great to permit treatment of the patient without interference of saliva; higher doses produced the desired effect, but secondary effects became so prevalent that per os administration became impractical. A series of 250 experiments were made in which ampules containing 0.25, 0.3, 0.35, 0.4, 0.45, 0.5, 0.8, and 1.0 mg. of Eumydrin per cc. were administered by injection. 7/10 to 8/10 of one cc. of a solution of 1 mg. Eumydrin per cc. produced the most favorable effect--decreasing the salivary flow sufficiently within 3-5 minutes for a period of one to one and one-half hours without producing undesirable secondary effects. When the entire cc. was administered, in some individuals the salivary flow ceased for 2-3 hours, causing undue discomfort.

Berg, M., and L. S. Fosdick, 1946. STUDIES IN PERIODONTAL DISEASE. II. PUTREFACTIVE ORGANISMS IN THE MOUTH. *Jour. dent. Res.*, 25 (2): 73-81.

Seventeen organisms isolated from the oral cavity ("Yeast A", "Yeast B", *Sarcina lutea*, *Streptococcus viridans* [*S. mitis*], *Bacillus subtilis*, *Gaffkya tetragena*, *Lactobacillus acidophilus*, *Proteus vulgaris*, *Pseudomonas aeruginosa*, *Staphylococcus albus* [*Micrococcus pyogenes* var. *albus*], *S. citreus* [*M. p. var. c.*], *S. aureus* [*M. p. var. a.*], *Actinomyces*, *Monilia albicans*, *Aerobacter aerogenes*, *Leptotrichia*, and *Neisseria catarrhalis*) were tested for putrefactive ability on variously treated saliva samples. Approximately 300 ml. saliva collected from several persons (number not given) was divided into three portions; two were heat-sterilized, one received no further treatment. Of the heat-sterilized portions, one was adjusted to pH 6.9 by the addition of dilute HCl, the other remained untreated with the pH resultant to heat-sterilization. Blood serum was added to half the tubes in each of the 3 groups, and all samples were tested both aerobically and anaerobically.

Protein degradation was determined by odor and formal titration.

Practically all the organisms played some rôle in the putrefaction of salivary proteins.

Under aerobic conditions: All the organisms in raw saliva, with the exception of *L. acidophilus*, *S. lutea*, *S. mitis*, and yeast, accelerated the normal putrefactive process. In the presence

of blood serum, there was usually an increase in the degree of hydrolysis and the rate of odor production, except when *L. acidophilus* was used. In heat-sterilized saliva samples (having no pH adjustment and in the absence of blood serum), only *N. catarrhalis*, *P. aeruginosa*, *P. vulgaris*, *A. aerogenes*, *S. lutea*, *Micrococcus p. var. citreus*, and *Leptotrichia* produced appreciable amounts of hydrolysis and odor; when blood serum was added, results were similar. In heat-sterilized, pH-adjusted samples, *P. vulgaris*, *P. aeruginosa*, *S. viridans*, *A. aerogenes*, *Leptotrichia*, and *M. catarrhalis* produced putrefaction; when blood serum was added, results were similar.

Under anaerobic conditions: In raw saliva, the odor concentration was similar to that produced aerobically, except at the end of 24 hours, when it was less; the degree of hydrolysis was usually the same. In the absence of serum, only elliptical yeast, *N. catarrhalis*, *M. albicans*, and *B. subtilis* failed to stimulate odor production. With and without the addition of blood serum, in heat-sterilized saliva only *N. catarrhalis*, *P. aeruginosa*, *P. vulgaris*, and *A. aerogenes* produced hydrolysis and putrefactive odors. Heat-sterilized, adjust saliva samples supported *N. catarrhalis*, *P. aeruginosa*, *B. subtilis*, *M. pyogenes var. aureus*, and *A. aerogenes*.

Berg, M., Dan Y. Burrill, and L. S. Fosdick, 1946a. CHEMICAL STUDIES IN PERIODONTAL DISEASE. III. PUTREFACTION OF SALIVARY PROTEINS. Jour. dent. Res., 25 (4): 231-246.

The rate of putrefaction of salivary proteins was studied by means of formol titration and by estimation of indole, tryptophane, sulfides, pH, pO, and oxidation-reduction potentials.

Patients, used for salivary tests, were divided into 4 groups: (1) those whose mouths showed no tendency to pocket formation, (2) those with shallow pockets or early bone regression, (3) those with a few deep pockets and general, but moderate, loss of bone, and (4) those with many deep pockets and extensive loss of bone. Group comparisons were made.

The rate of salivary putrefaction, known to occur more readily in individuals with periodontal disturbances than in normal individuals, was determined both anaerobically and aerobically. Incubations were also made with additions of casein to the substrate, since preliminary results indicated that the amount of protein may be a limiting factor.

Paraffin-stimulated saliva was collected and immediately incubated. Samples were removed for analysis after 1, 3, and 24 hour incubation.

In aerobic incubation, 45-50 cc. of fresh saliva were incubated in a cotton-stoppered flask at 37.5°C. and 15 cc. samples were removed for analysis. When saliva was incubated aerobically with casein, 15 cc. portions of saliva were placed in three 50 cc. screw cap vials to which 150 mg. of casein had been added. The vials were kept in motion during incubation at 37.5°C.

In anaerobic incubation, three 15 cc. portions were placed in 20 cc. screw cap vials, with the addition of glass beads to facilitate mixing.

Procedures for chemical testing of free carboxyl groups, for analysis of indole, tryptophane, sulfide, and for measurements of pH, pO, and oxidation-reduction potentials are described.

Ten tables of data are presented.

Comparing the results obtained with the four groups of saliva, the following relations were found: (1) Hydrolysis progressed much more rapidly in the pathological cases than in the normal ones; (2) Indole production was more rapid in the pathological saliva than it was in the normal. At 24 hrs., there was little variance between the two groups, presumably because all reactions had approached completion. Significant differences occurred at 1 hr. and 3 hrs. (3) Sulfide production followed the trend of indole production. A peculiar phenomenon occurred in many cases of aerobic incubation, wherein there was a rise in sulfides at the beginning and a distinct decrease at 24 hrs. Significant differences, in general, occurred between all groups; the greatest differences between groups occurred in anaerobic incubation (with casein) at the 1 hr. and 3 hrs. levels. (5) Odor concentration readings, considered accurate up to a pH value of 6, showed that pathological saliva putrefied much more rapidly than did the normal saliva, with particularly significant results when saliva was incubated anaerobically with casein.

Differences in pH, Ec (the oxidation-reduction potential), EH (single electrode potential), rH*, and in the neutralizing capacity of saliva, proved to be of little significance.

Berg, M., D. Y. Burrill, and L. S. Fosdick, 1947. CHEMICAL STUDIES IN PERIODONTAL DISEASE. IV. PUTREFACTION RATE AS INDEX OF PERIODONTAL DISEASE. Jour. dent. Res., 26 (1): 67-71.

Samples of paraffin-stimulated saliva were collected from each of 200 patients (100 with apparently normal periodontal conditions and 100 with abnormal or pathological periodontal conditions). The specimens were divided into two 15 cc. portions. 100 mg. of casein were added to each portion and air bubbles were eliminated. The vials were then sealed and placed in an agitating device in an incubator at 37.5°C. One vial was removed for analysis after 1 hour; the other, after three hours.

Indole production, sulfide production, and amount of hydrolysis were determined. A periodontal disease index was devised expressing all analyses for each group and for each individual patient in a single figure. This index was based on the formula, $A + 2B$ (A representing the values obtained for 1 hour incubation; B representing values obtained at 3 hours incubation).

In general, results showed that saliva from pathological cases putrefied more rapidly than normal saliva. There was good correlation between chemical findings of the tests and the radiographic and clinical findings of examinations done for each patient before the chemical analyses were begun.

Bergeim, Olaf, 1926. INTESTINAL CHEMISTRY. III. SALIVARY DIGESTION IN THE HUMAN STOMACH AND INTESTINE. Arch. int. Med., 37 (1): 110-117.

A study made of human subjects, using a retention stomach tube for the withdrawal of the gastric contents, revealed that 54-84% of an

*rH = $2pH + EH/30$, where Eh is expressed in millivolts.

ingested meal of potato starch and 46-68% of an amount of crustless bread were digested (converted into maltose and dextrin) during the normal course of a thirty-minute meal. The presence of amylase in the gastric samples was detected 15-30 minutes after the start of the meal, but was found to be absent 15 minutes after the meal was ended.

The salivary digestive powers proved to be inactivated by free stomach HCl and boiling, and could not be re-activated by the addition of more amylase, starch, digestion products, or by neutralization of the detrimental acid medium.

It is indicated that although an initial high gastric acidity would stop the digestive processes of salivary amylase on starch, near-complete digestion occurs if the food is well masticated and the enzymes are allowed to act upon the bolus for at least 15 minutes before the material is subjected to free HCl.

Bergeim, Olaf, and W. F. Barnfield, 1945. LACK OF CORRELATION BETWEEN DENTAL CARIES AND SALIVARY AMYLASE. *Jour. dent. Res.*, 24 (3-4): 141-142.

No correlation was found between the amylase activity of paraffin-stimulated saliva of 250 medical and dental students and the extent of their dental caries.

Bergmann, J., 1903. DER SPEICHEL ALS HEILFAKTOR [Saliva as a healing factor]. *Therapie der Gegenwart*, 5: 200-202.

A brief historical review of the healing qualities of saliva is presented. Its significance as a therapeutic agent in 1) throat inflammations, 2) gastric hyperacidity, 3) obesity, and 4) dropsy, is discussed.

Bergve, Einar, 1938. LACTOBACILLUS ACIDOPHILUS FORGJAERER SUKKER (RRSUKKER) [Lactobacillus acidophilus ferments sugar (cane sugar)]. *Norsk Tannlaegefor. Tidende*, 48 (1-2): 7-8.

A comparison of the saccharolytic activity of *Lactobacillus acidophilus* cultures in tomato bouillon (pH 6.4) containing cane sugar, both in combination with and without saliva from healthy persons, showed that the action was not enhanced by the presence of saliva. When saliva from caries-active persons, however, was used, the pH soon dropped to 3.6-3.3, a pH optimum for the enamel destruction associated with dental caries.

Bernhard, Carl Gustaf, 1938. EXPERIMENTAL STUDIES ON CONDITIONED SALIVARY RESPONSES IN CHILDREN. *Acta pediat.*, 28 (1): 118-128.

"Experiments with conditioned reflexes were performed on a healthy boy, 9 years old, with the method of Krasnogarski. All conditioned reflexes were based on alimentary unconditioned reflexes, and the saliva from the right parotid gland was measured by a drop recorder. Each conditioned stimulus acted alone during 30 seconds, during which time the conditioned secretion was recorded. A system of conditioned reflexes was set up, consisting of 5 positive and 2 negative conditioned reactions. Positive conditioned reflexes were formed to red light (3 times) metronome signal (100 beats per minute, once) and the sharp sound of a buzzer (once). Another metronome-signal (150 beats per minute) served as negative stimulus. In addition a conditioned

inhibitory effect was formed on the light reaction by skin stimulation on the boy's right ankle. In experiments carried out under identical conditions 4-5 times a week this condition reflex system was used. In all 17 experiments were performed.

"The conditioned secretion caused by red light was an average of 13.2 ± 0.4 drops (50 observations), and the figure shows the striking regularity of the conditioned reflex action. The conditioned secretion of the positive metronome signal was 13.4 ± 0.4 drops (15 observations), and the much stronger sound of the buzzer caused an average of 15 ± 0.5 drops. The probable statistical difference is a proof for the validity of the law of force. The inhibitory reactions showed a similar marked regularity, the average of the secretion being 2.0 ± 0.2 drops (34 observations).

"Further experiments were performed on the same boy in which conditioned reflexes were established on a taste stimulus. 2 cc 0.4 percent NaCl, which gave no marked unconditioned sensation of salt, was used as conditioned stimulus. After being reinforced 4 times a conditioned reflex to the taste stimulus was established. From the 35 observations in the ensuing experiments the average of the conditioned secretion was calculated to be 13.7 ± 0.3 drops. A negative conditioned reflex was formed on skin stimulation together with salt, and later on 2 cc water was used as conditioned inhibitor on the positive salt reaction. The water preceded the salt solution by 2 seconds, and the inhibitory effect was evident after six applications." (Author's summary.)

Bernfeld, P., A. Staub, and Ed. H. Fischer, 1948. SUR LES ENZYMES AMYLOLITQUES. PROPRIÉTÉS DE L' α -AMYLASE DE SALIVE HUMAINE CRISTALLISÉE [On amylolytic enzymes. Properties of α -amylase of human crystallized saliva]. *Helvet. chim. Acta*, 31 (7): 2165-2172.

"The α -amylase of human saliva is protein in nature and contains no phosphorus. The enzyme is active in the pH range of 3.8-9.4, with optimum activity at pH 6.9. With regard to temperature, its optimum activity occurs at 40°. The presence of the chlorine ion is necessary to its activity. Some other anions exercise a similar, although reduced, action. In decreasing order of action, these are Br', NO₃', and I'. The pure enzyme is stable at 20° between pH 4.5 and 11. It is not deactivated by dialysis, provided that the determination of its activity is done in the presence of NaCl.

"The enzymatic action of the α -amylase is identical to that of the α -amylase of the pancreas of the pig, but the chemical composition of these two enzymes is not the same. The electrophoretic mobility, the stability with regard to pH, the solubility in water, and the activity per unit weight of the enzymes are all different.

"The α -amylase is the only enzyme of saliva which acts on starch or on its degradation products." (Authors' summary, translation.)

Berke, Joseph D., 1935. ETIOLOGY AND HISTOLOGY OF DENTAL TARTARS. *Dent. Cosmos*, 77 (2): 134-139.

A histological study of salivary calculi or tartar on teeth reveal these to be a calcareous formation in an organic matrix which is composed

principally of mycelial threads. Differential staining showed the presence of a large number of Gram-positive cocci, some spirochetes and fusiform bacilli; the bacilli were few in number. Blood pigments and organic stains appeared to give the tartar its characteristic coloring. Phagocytic cells were also noted, especially in a soft, grayish "inflammatory" type of tartar usually found above the gingival attachment. The occurrence of tartar is considered a pathological process which is facilitated by ulcerated gingivae, or disturbance of the calcium-phosphorus metabolism to produce changes in the chemical constituency of saliva.

Berri, M. IA., 1948. LOKAL'NYI p.H. V POLOSTI RTA [The local p.H. in the mouth cavity]. Stomatologiiâ (Moskva), 2: 20-27.

The local pH was studied in the mouth cavity and in the saliva of 107 people, healthy individuals or ambulatory patients from 16 to 50 years of age, divided into three groups according to their dental condition. Electrometric determinations were made, using antimonite and silver antimonate electrodes, and an agar siphon. The pH values were established for the palatal, proximal and lip regions of the upper and lower incisors, canines, and the right and left molars, and for the mixed saliva.

Results of 518 measurements showed great variation in pH, ranging from 4.0 to 8.4; 68% of the measurements showing 7.1, and 24% less than 6.1. A considerable difference was observed between the reaction of the mixed saliva (pH often above 7.0) and that of the various portions of the mouth, which can be as high as 1 to 2 pH units, the reaction of the surface of the teeth being mostly acid. Moreover, great divergencies were observed in the pH of the various portions, even between adjoining regions. The low pH values must be ascribed to the action of acids produced by the microflora of the mouth. The difference between the upper and lower teeth is very sharp, the acid reaction being found much more often in the upper than in the lower teeth region together with lower pH values. In individuals with multiple caries, the local pH is mostly lower than in individuals with healthy teeth; in 38% of the cases it is below 6.1, in 73.3% below 7.1.

Berry, Helen Kirby, 1951. FURTHER STUDIES ON INDIVIDUAL URINARY AND SALIVARY AMINO ACID PATTERNS. Univ. Texas Pub. No. 5109: 157-164.

The salivary amino acid patterns of 9 individuals (6 males, and 3 females) were determined by one-dimensional paper chromatography. The samples were chromatographed in amounts of 25 to 200 microliters, employing phenol-sodium citrate-sodium phosphate solution. Quantitative values were expressed as micrograms per milliliter of saliva [cf. Table II, p. 163]. Urine samples were similarly studied.

Consistent individual patterns of amino acid secretion were apparent. Of six known amino acids listed, 3 individuals secreted all of the acids in varying amounts, 1 individual secreted 5, 4 individuals 3, and 1 secreted no detectable amounts of any. All of the individuals secreted an unknown amino acid (R_f -.65 in phenol). The urinary lysine of one individual (A) whose salivary lysine was 10 times that of individual B,

was present in unusually high amounts, indicating a general metabolic difference.

Berry, Helen Kirby and Louise Cain, 1951a. QUANTITATIVE STUDY OF URINARY AND SALIVARY AMINO ACIDS USING PAPER CHROMATOGRAPHY. Univ. Texas Pub. No. 5109: 71-76.

Saliva samples were analyzed for amino acids by two-dimensional chromatograms (essentially the method of Polson, Biochim. et biophys. Acta., 2: 575. 1948) in which the phenol solvent was used for the initial development, and 2,6-lutidine solvent for the other dimension. The method is described in detail.

Substances identified were aspartic acid, glutamic acid, serine, glycine, taurine, alanine, citrulline and/or glutamine and/or β -alanine, valine, leucine, methionine sulfoxide, lysine, threonine, tyrosine, histidine, cysteine acid, methyl histidine (?), proline, α -amino butyric acid, cystine, phenyl alanine, arginine, tryptophan, "nephrosis peptide"?, and methionine sulfone. Extensive studies of spot #26, the principal amino acid in all salivary samples investigated, failed to identify it.

Berry, Helen Kirby, Harry Eldon Sutton, Louise Cain, and Jim S. Berry, 1951b. DEVELOPMENT OF PAPER CHROMATOGRAPHY FOR USE IN THE STUDY OF METABOLIC PATTERNS. Univ. Texas Pub., No. 5109: 22-55.

The general techniques and materials of paper chromatography, applicable to saliva analysis, are described in detail.

Bertcher, R. W., L. M. Meyer, and I. F. Miller, 1958. Co⁶⁰ VITAMIN B₁₂ BINDING CAPACITY OF NORMAL HUMAN SALIVA. Proc. Soc. exper. Biol. Med., 99 (2): 513-515.

The centrifuged supernatant from chewing gum-stimulated salivas, of 103 healthy subjects, in 1 ml. aliquots was incubated for 2 hours at room temperature with amounts of Co⁶⁰ vitamin B₁₂ varying from 1 to 100 m g., prior to 48-hour dialysis in cold running tap water. Bound vitamin B₁₂ was measured in terms of residual radioactivity by means of a well-type scintillation counter. The salivary binding capacity was found to vary from 13 to 80 m g./ml., with a mean value of 31 ± 10.2 m g./ml. The salivary binding capacity tended to be constant for a subject, in tests of samples collected from 8 subjects at hourly intervals over a 4-hour period as well as from 6 subjects at varying intervals of days or weeks. Tests of 50 samples of saliva showed a tendency for persons under 30 years of age to have higher vitamin B₁₂ binding capacity than older subjects; no correlations were found between the salivary binding capacity and salivary specific gravity, refractive index, optical density at 280 m., leukocyte count, as well as ABO blood groups, and salivary secretion of blood group substances. The study indicates the presence of a single binding factor in saliva.

Besta, Bruno, and Helga Kuhm, 1935. UNTERSUCHUNGEN ÜBER ANTAGONISMUS ZWISCHEN DIPHTHERIE-BACILLEN UND ANDEREN BAKTERIEN [Investigations on the antagonism between diphtheria bacilli and other bacteria]. Zeitschr. Hyg. infektionskrankh., 116 (5): 520-536.

In vitro studies of the interaction of various bacteria are reported. Observations of diphtheria bacilli [*Corynebacterium diphtheriae*] and Friedländer's bacillus [*Klebsiella pneumoniae*] on blood agar plates showed a more or less synergistic action. When such plates were prepared with 10, 25, and 50% saliva and incubated for one day at 37°C, the growth of diphtheria bacilli, streptococci, and pneumococci [*Diplococcus pneumoniae*] was inhibited; growth of Friedländer's bacillus was somewhat inhibited. *Bact. coli* [*Escherichia coli*], typhoid [*Salmonella typhosa*], and anthrax bacilli [*Bacillus anthracis*] were unaffected. No inhibition was noted when the saliva was heated at 56°C for 30 minutes, or when the saliva was filtered through a Berkefeld.

Betelman, A. I., 1938. POLNOTSENNYI AKT ZHEVANIĖ I OTDELITEL'NAĖ ROBOTA SLIŪNNYKH ZHELEZ [Thorough mastication and the secretory function of the salivary glands]. Stomatologiya, (Moskva), 2: 26-30.

Study was made of salivary response in a dog having a parotid fistula to dry or moist rusk offered in pieces or powder form, to dry or moist white bread and to liquid millet cereal. A series of 147 tests were conducted in the fasting animal; food was offered for 2 minutes and saliva collected for 4 minutes at 15 minute intervals during one hour or alternate days. Determinations were made of salivary viscosity, organic and inorganic content and dry residue. Results show that dry rusk powder elicited the most saliva (7.5 cc.), followed by large, dry rusks (6.9-7.0 cc.), small rusks (5.3 cc.), large moist rusks (3.6 cc.), moist rusk powder (3.2 cc.), and moist white bread (2.4 cc.). The percentage of organic matter was 1.5 times greater than the ash in the dry residue of saliva stimulated by dry or moist rusk powder; this percentage was 2.6 times greater in saliva elicited by the other substances. Chewing action appeared to play an important part in stimulating salivation. The dryness, compactness of size of the particles are considered the most important sialogogic factors due to their mechanical action in the oral mucosa and not to the dehydrated state in itself. The larger the food particles in general the greater was the stimulation.

Betelman, A. I., 1938a. VZAIMOSVIĖZ' MEZH DU SOSTOIĖNIEM ZUBOCHELIŪSTONI SISTEMY I SEKRETORNOI DEĖĖTEL'NOST'Ė SLIŪNNYKH ZHELEZ [The interrelation between the condition of the dental-maxillary system and the secretory function of the salivary glands]. Stomatologiya (Moskva), 6: 89-93.

Study of the relationship between salivation and dental condition was continued (Betelman 1938m), using the same experimental technique and animal. One hundred tests were made in the dog, all of whose lower teeth were extracted, using dry or moist rusk or rusk powder in large or small portions as salivary stimuli. Test results, analogous to those of the preceding study, show dry rusk powder to stimulate the highest flow rate (8.80 cc.) followed by large dry rusks

(7.45 cc.), large moist rusk (4.70 cc.), and by moist rusk powder (3.80 cc.). Dry pieces of rusk elicit 1.6 times more saliva than moist, dry rusk powder 2.3 times more than moist; large rusks elicit more secretion than small. Previous conclusions are thus supported. Comparison of data shows, however, that more saliva (6.5 to 30%) is secreted in response to all of the stimuli after the teeth extraction than before; the salivary glands increase their activity to compensate for the insufficiency of the impaired dentition. In a damaged dental condition the salivary dry-residue percentage is also increased (8 to 20%), except for moist large rusk. The percentage of organic substance in the saliva elicited by dry or moist rusk powder and dry large rusk is larger (6 to 39%) than in the saliva before teeth extraction. Saliva in response to dry small rusks and moist large rusk contains less organic substance after teeth extraction than before.

Bézi, István, 1932. A STUDY OF ACTION OF SALIVA AND EXTRACT OF TONSILS UPON DIPHTHERIA BACILLUS AND DIPHTHERIA TOXIN. Jour. Immunol., 22 (1): 1-17.

Saliva was collected from hospital patients and from normal individuals in an attempt to find if there was any local immunizing ability in saliva before or during an infection with diphtheria bacilli, *Corynebacterium diphtheriae*. Two strains of diphtheria, grown on Loeffler agar slants, were washed with 10 cc. each of sterile saline solution and of filtered sterile (Berkefeld "N" filter) saliva. The washings were divided into 3 parts and were kept at room temperature, in the ice box, and at 37°C. Intracutaneous injections, of 0.1 and 0.2 cc., were made into guinea pigs at increasing intervals of hours and days. Viability of the organisms was tested at intervals by transfer of a loopful of each of the materials to Loeffler slants.

A diphtheria toxin and saliva mixture was kept and administered in a similar manner, the 0.1 cc. injection containing 0.02 M.F.D. in equal amounts of saliva and saline.

Skin tests were read and recorded after 24 hours or later. Photographic records were made, usually several times at the height of the reaction.

Some inhibitory-bactericidal action of saliva was noticed in 3 of the 14 samples. In 2 of these 3, the saliva was that of a Schick-negative person. In 3 cases where saliva was collected from diphtheria patients (in an acute, a convalescent, and a carrier state) no antibacterial action was demonstrated either against the test strain or against the one isolated from the patient.

Against diphtheria toxin, the saliva does not exert any neutralizing effect demonstrable by this method.

Additional experiments, similar to those with saliva, were carried out with extracts of tonsil and other tissues and either diphtheria bacilli or diphtheria toxin.

Bibby, Basil Glover, 1931. A STUDY OF A PIGMENTED DENTAL PLAQUE. *Jour. dent. Res.*, 11 (6): 855-872.

Approximately 160 salivary examinations of persons having plaques were made. In all cases but one, the amounts of saliva and the viscosity were normal. Calculus was present in 8%, usually on teeth other than those having plaque. The author concludes that salivary changes (i.e. those leading to calculus formation) are unimportant in the formation of plaque.

The precipitation of salivary proteins (i.e. mucin and globulin), which would serve as nutrients for proteolytic and chromogenic bacteria, may be of importance in plaque formation.

Bibby, Basil G., 1935. METHOD FOR ESTIMATING BACTERIAL FLORA OF MOUTH. *Jour. dent. Res.*, 15 (3-4): 170.

The following method is suggested for estimating percentage distribution of bacteria in various oral areas: "Materials to be examined are mixed with a suitable diluent, such as diluted broth, and shaken in a tube with glass beads until homogeneous suspension results. Four smears are prepared by spreading 0.2 cc. on each of four slides, which, after drying in the air at room temperature, are stained with iodine and by the methods of Gram, Ljubinsky, and Fontana.

In the slide stained by Gram's method, the percentage of each of nine morphological 'groups' of Gram-positive and Gram-negative organisms is determined. Ljubinsky and iodine stains show percentage of various filamentous types. Fontana stain gives percentages of different types of spirochetes and their relative proportions to other forms. In these examinations, fields are chosen which are representative of the distribution of bacteria on the slide, and counts of eight or nine of the fields are made until the total number of organisms counted is 250. Percentage distributions are then calculated. Duplicate counting of Gram-stained preparations has shown that results can be reproduced with an average difference of not more than about 1 or 2 percent, and a probable error of from 2 to 3 percent."

Bibby, Basil G., 1935. VARIATIONS IN BACTERIAL FLORA IN DIFFERENT MOUTHS. *Jour. dent. Res.*, 15 (3-4): 208.

The floras of 16 mouths (4 free from caries and gingival lesions; 4 with rampant caries; 4 with gingivitis; and 4 with advanced pyorrhea) were compared to determine any characteristic variation accompanying the particular disease. A high percentage of Gram-positive cocci (56.5%) occurred in washings of pyorrheal mouths; Gram-positive bacilli were completely absent in the materia alba from the carious group; they occurred, however, in a comparatively high percentage (10.2%) in the materia alba from pyorrheal mouths; and filaments composed 26.9% of the bacterial flora in the materia alba from caries-susceptible mouths.

Bibby, Basil G., 1935. EVALUATION OF CULTURE MEDIA FOR STUDY OF ORAL BACTERIA. *Jour. dent. Res.*, 15 (3-4): 207-208.

Both liquid and solid media were tested to determine under what conditions organisms from the mouth cavity would reproduce and maintain

their original percentage ratios. It was seen that media containing only inorganic salts favored chromogenic bacilli, excluding all others; saliva- and starch-containing media (low in other nutrients) were selective for leuconostoc-like organisms; acid media having high-carbohydrate contents were suitable for yeasts and Gram-positive cocci; Loeffler's serum, Douglas broth, Douglas agar, blood agar, and media containing tellurite greatly enhanced the percentages of Gram-positive cocci (inclusion of dyes reduced this disparity).

Bibby, Basil G., 1935c. THE FORMATION OF SALIVARY CALCULUS. *Dent. Cosmos*, 77 (7): 668-676.

A survey of the literature on calculus formation shows calcium precipitation to be attributed either to the effect of micro-organisms or to the chemical or physical environment of the mouth.

A group of experiments with paraffin-stimulated saliva, designed to evaluate the combined effect of several factors on calcium precipitation, tested the effect of bacterial activity, loss of CO₂, as well as the presence of alkalis and phosphatase. Special media, incorporating calcium phosphate and carbonate plus sodium phosphate, was used to study the effect of bacterial cultures on calcium precipitation. Calculi recovered from the human and the dog mouth were examined for occurrence and type of bacteria present, as well as for the structure of the calculus. The investigation also included aerobic and anaerobic culture of bacteria from freshly-removed human calculi.

The results show that calculus formation occurs only in the presence of bacteria which possibly may produce the physico-chemical precipitation of calcium salts from the saliva. Bacteria appear to be an important factor in fixation of the deposits when calcium precipitation has occurred.

Bibby, Basil G., 1937. BACTERIOSTATIC AGENTS IN HUMAN SALIVA. *Jour. dent. Res.*, 16 (4): 325-326.

"Properties of salivary anti-bacterial-agents, effective against selected types of bacteria, were compared to determine whether any agent responsible for effects manifested, and whether identical with lysozyme of egg white--used as basis for comparison because of ready availability. All anti-bacterial agents resisted storage at refrigerator and incubator temperatures, 5-15 days. Inability of salivary anti-lysodeiktic agent to pass Berkefeld-N filter, and resistance to boiling, set it apart from lysozyme and salivary agents effective against other organisms. Latter agents: appear in Berkefeld-N filtrates after filtering 10 or 15 cc. of saliva; destroyed at temperatures above 80°C. Salivary anti-lysodeiktic agent resembled lysozyme in solubility in 0.8 percent NaCl, and ability to induce lysis of suspensions of organisms--properties shared by no other salivary anti-bacterial agent. Conclusions: Apparently no anti-bacterial agent in saliva identical with lysozyme of egg white; at least two anti-bacterial agents in saliva." (Author's abstract)

Bibby, Basil G., and Rita P. Ball, 1937a. EFFECT OF SALIVA ON GROWTH OF BACTERIA. *Jour. dent. Res.*, 16 (4): 325.

The bacteriostatic effects of at least four different salivas on 17 types (117 strains) of bacteria were studied. The salivas were added to wells cut into hardened seeded agar plates; inhibition was manifested as colony-free zones about the wells. The saliva had a bacteriostatic effect against organisms not usually present in the mouth; the effect was slow or absent against organisms usually present.

Bibby, Basil G., 1938. A COMPARISON OF THE BACTERIAL FLORA OF DIFFERENT MOUTHS. Jour. dent. Res., 17 (5): 423-429.

A comparison was made of the oral bacterial flora of five series of four patients each, representing patients with normal mouths, with slight caries, with rampant caries, with gingivitis, and with pyorrhoea. Six specimens were collected from each mouth from mouth washings, fissures, posterior molars, smooth surfaces, gingival crevices and the buccal mucosa. An attempt was made to correlate the findings with the state of oral health.

The method of procedure is described; the smears were stained by Gram's method and with Ljubinsky's stain.

No significant relationship could be determined between the oral flora and the state of oral health. It was, however, noted that in gingival smears the irregular occurrence of Gram-positive cocci was obvious in all series; Gram-negative cocci, although consistently of high percentages (range 49.4-56.8), showed similarly wide variations in the rampant caries series; and percentages of Gram-negative filaments were high in the gingivitis series (10.9-20.5) and low in the pyorrhoea series (2.2-6.5). In the mouth washings, the Gram-positive cocci represented an outstanding deviation in the pyorrhoea series (51.2-61.0) being almost 7 percent higher than those of any other series. In the fissure smears, the Gram-positive cocci again occurred in the highest percentages in the pyorrhoea series (range 26.9-35.1). Bacterial counts from the posterior molar surfaces showed high percentages of Gram-negative filaments, of which the highest uniform series was from the normal mouths (range 12.9-20.5). No characteristic variations were noticed in smears from the smooth surfaces. Smears from the buccal mucosa were characterized by high percentages of Gram-positive cocci and by a reduction of all other organisms.

Bibby, Basil G., 1938a. THE BACTERIAL FLORA IN DIFFERENT PARTS OF THE MOUTH. Jour. dent. Res., 17 (6): 471-476.

A comparison of 276 smear counts of the bacterial flora obtained from ten different parts of the mouth failed to demonstrate any distinctive composition. Wide variations in the percentages of bacterial groups (cocci, bacilli, and filaments) occurred in all series of counts.

In general, indefinite and slight differences existed among the various parts of the mouth. High percentages of Gram-positive cocci were present in mouth washings; filamentous organisms were found in highest percentages on the posterior surfaces of the lower molars; the occlusal fissures were characterized by a low percentage of Gram-positive bacilli and high occurrence of Gram-negative filaments; the buccal surfaces of the upper molars harbored great numbers of

filaments, particularly Gram-negative forms; Gram-positive cocci and total cocci were most prevalent in smears from the buccal mucosa; a relatively high percentage of Gram-positive granular fusiform bacilli was encountered on the gingival margins; and dental cavities were characterized by a slightly higher number of Gram-negative cocci than were other regions.

The author feels that, regardless of the failure to demonstrate distinctive floras in various parts of the mouth, more definite differences may exist.

Bibby, Basil G., 1938. ANTIBACTERIAL AGENTS IN HUMAN SALIVA. Jour. dent. Res., 17 (4): 308.

"Salivary antibacterial agent effective against Micrococcus lysodeikticus, Bacillus megatherium, and sarcina will not pass Berkefeld filter, is only slightly weakened by temperatures of 75°C. for 5 minutes, resisting 100°C. for 15 minutes, is destroyed by ultraviolet radiation, is inactivated by storage for 12 days at 20°C. and 24 hours at 37°C. but survives 2 months refrigeration (8°C.), is adsorbed on kaolin and charcoal, but not on aluminum oxide, is completely precipitated by acetone and partially precipitated by acid. The agent effective against staphylococci, streptococci, lactobacilli, and colon-typhoid organisms, passes Berkefeld filter, is destroyed in 5 minutes by temperatures of 75°C.; resists ultraviolet radiation; survives 2 months refrigeration and 24 hours incubation; is adsorbed on kaolin and charcoal but not on aluminum oxide; is only partially precipitated by acetone and is completely inactivated by acid. Properties of lysozyme of egg white resemble those of first agent but lysozyme passes filter, survives ultraviolet radiation and storage at 20°C. and 37°C.. Amylase, on the other hand, bears more resemblance to second antibacterial agent and its properties differ in no essential detail." (Complete paper).

Bibby, Basil G., Maynard K. Hine, and Oliver W. Clough, 1938c. THE ANTIBACTERIAL ACTION OF HUMAN SALIVA. Jour. Amer. dent. Assoc., 25 (8): 1290-1302.

The antibacterial action of human saliva was tested on 169 strains of bacteria by means of a well-plate method (described in detail). Microbes varied in their reaction, from very susceptible (Micrococcus lysodeikticus, Bacillus megatherium) to non-susceptible (streptococci or staphylococci isolated from the mouth); the growth of a total of 110 strains was inhibited. Differences in salivary potency occurred from individual to individual and in the same individual at different times. No correlation between the inhibitory action and the immunologic state (health) of the individual could be established. It is, however, suggested that the inhibitory agent (or agents) regulates the oral bacterial flora.

Bibby, B. G., and Mary Van Kesteren, 1939. ACID PRODUCTION BY ORAL STREPTOCOCCI AND LACTO-BACILLI. Jour. dent. Res., 18 (3): 266-267.

"Comparisons were made of the numbers and the acidogenic activity of streptococci and lactobacilli isolated from 12 mouths with active caries. Streptococci were consistently more numerous (average 3,300,000 per cc. of saliva) then

were lactobacilli (av. 131,000 per cc.). Streptococci also produced acid more rapidly, changing indicator after 5 to 10 hours as compared with 9 to 20 hours required by same size inocula of lactobacilli. After 24 hours the titratable acid produced by streptococci was somewhat less (av. 2.1 cc. N/10 acid) than that produced by the lactobacilli (av. 3.1 cc. N/10 acid. Tests in sugar mixtures containing 50 percent of saliva gave comparable results. Since the rapidity of the bacterial fermentation of carbohydrates is a fundamental factor in dental caries, the results indicate that streptococci are more important than lactobacilli in the production of decalcifying acids." (Complete paper.)

Bibby, B. G., and M. Van Kesteren, 1940. THE EFFECT OF FLUORINE ON MOUTH BACTERIA. *Jour. dent. Res.*, 19 (4): 391-402.

Oral microorganisms were exposed to various concentrations of sodium fluoride solutions comparable to those inhibiting dental caries; the effect on microbial growth and acid production was observed. Similar studies were conducted using fluorosed and fluorine-treated dental tissues. Procedures are described in detail.

Streptococcal strains (14) produced acid most rapidly in the first 8 hours, decreasing until virtually no acid was produced after 24 hours. The reduction of acid formation was proportional to the increasing fluoride concentrations. At 1000 ppm., no definite growth was observed; titratable acidities were comparable to those of uninoculated controls. No bactericidal effect was produced by fluoride concentrations of 100 ppm. or less. In the presence of fluoride, acid production occurred as long as bacterial growth was rapid. In the absence of fluoride, acid production continued until its concentration proved bactericidal (pH from 4.0-4.5 attained at approximately 20 hours).

Lactobacillus strains (12) produced less acid than streptococci but for longer periods of time (24 to 72 hrs.). At 24 hrs., low concentrations of fluorine produced no marked effects; at 72 hrs., the results were more noticeable. Fluorine concentrations of 1000 ppm. were bactericidal.

The action of fluorine on acid production of micrococci (4 strains), Gram-negative cocci (3), actinomyces (2), fusiform bacilli (2), leptotrichia (2), and a Gram-negative bacillus were tested. No acid was produced by the Gram-negative bacillus and leptotrichia; amounts of acid produced by the remaining strains were intermediary to that of the lactobacilli and that of streptococci. Concentrations of 1000 ppm. were markedly bacteriostatic; reduction in acid production up to that level were proportional to the fluoride concentration.

In general, lower concentrations of fluorine limited acid production but concentrations greater than 250 ppm. were required to affect bacterial growth.

Incorporation of fluorosed and fluorine-treated enamel and dentin in cultures of oral microorganisms reduced acid production.

Bibby, B. G., and Dorothy W. Maurer, 1941. BACTERIAL COUNTS IN SALIVA. *Jour. dent. Res.*, 20 (3): 258.

"Comparisons of the number of organisms estimated by cultural methods and direct counting

procedures confirm the findings of other investigators in showing that only a small percentage of the total bacterial population is revealed in plate counts. Because different counts were found in plates made from different dilutions of saliva it seemed possible that agglutination of organisms might be influencing the results. Comparisons of the occurrence of clumps of bacteria in hemocytometer counts, and colony counts made from fresh and standing saliva indicated that agglutination was taking place. Of the various methods used to reduce the spontaneous agglutination of salivary organisms the addition of 1 percent of horse serum to standing saliva or saliva dilution tubes has been the most satisfactory. By following such a procedure plate counts averaging 16.8 percent of the total flora have been obtained, a percentage 6 times greater than that reported by previous authors." (Author's abstract.)

Bibby, B. G., J. F. Volker, and M. Van Kesteren, 1942. ACID PRODUCTION AND TOOTH DECALCIFICATION BY ORAL BACTERIA. *Jour. dent. Res.*, 21 (1): 61-72.

A comparison of the average values for salivas of 12 carious children (average age, 11.3 years) and those of 7 non-carious adults (average age, 30 years) revealed the following (non-carious group in parentheses):

Total bacteria per cc. saliva, 247,600,000 (1,130,000); acid formers, 68% (71%); streptococci per cc. saliva, 3,287,000 (21,730,000); lactobacilli, 131,275 (3,270); and yeast cells, 9,986 (70). There were 9.3 cavities (1.5).

Wide variations occurred from mouth to mouth both in numbers and relative percentage of different types of organisms. In view of these variations in both groups, no relationship between the numbers of any particular group of organisms and caries activity could be established.

Bibby, B. G., and Dorothy W. Maurer, 1942a. RELATIONSHIP BETWEEN ACID PRODUCTION BY SALIVA AND ITS BACTERIAL FLORA AND CARIES. *Jour. dent. Res.*, 21 (3): 328-329.

To determine the significance of the acidity and the bacterial flora of saliva in dental caries, the acid formation and the microorganisms of paraffin-stimulated saliva of 54 individuals (22 with active caries, 13 with moderate caries, and 19 without caries) were studied. Glucose was added to two samples collected from each individual to give a 1% 5-cc. solutions. One sample was incubated at 37°C. for 6 hours, then titrated with N/10 alkali; the other was titrated 24 hours after addition of 200 mg. powdered dentin.

Counts were made by hemocytometer and plating. Patients with active caries had a greater acid production than those of the other two groups. The active-carries group averaged 2.05 cc. at 6 and 4.15 cc. of N/10 acid at 24 hours; the moderate-carries group averaged 1.19 and 3.51 respectively; and the caries-free group, 1.68 and 2.75 respectively. The acidogenic streptococcal count was highest in the caries-free group; the lactobacillus and yeast counts paralleled the acid formation in the different groups. The differences between acid production and bacterial count at 6 and 24 hours were statistically significant (no concrete data presented). A high degree of constancy was observed when tests were repeated on the same individual.

The author suggests that the total bacterial count is the most important factor responsible for the different activities in acid production.

Bibby, B. G., and Irene MacKinnon, 1943. BACTERIAL GROWTH AND ACID PRODUCTION IN SALIVA. *Jour. dent. Res.*, 22 (3): 219-219.

"To indicate whether acid production by salivary organisms was most closely related to the total bacterial count, the streptococcal count, the lactobacillus count or the rate of growth of these organisms, tests were made on the salivas of 15 patients with low caries, 13 with high caries and 7 with moderate caries. One percent glucose was added to 2 aliquots of paraffin-stimulated saliva one of which was incubated in the ordinary way at 37°C, and the other of which was mechanically agitated during incubation. Hemocytometer, (total bacteria), oatmeal bread culture (streptococcus) and tomato juice agar culture (lactobacillus) counts were made at the beginning of the experiment and at 4 hours, 8 hours and 24 hours afterwards. The pH was measured colorimetrically at each interval and acid titration made at 8 and 24 hours. In non-agitated tests acid production was most rapid during the first 8 hours but continued for the duration of the tests. The total bacterial count and the lactobacillus counts showed, especially in the low caries tests, accelerated growth after 8 hours, whereas the streptococcal population reached its high point at 4 hours and decreased thereafter. The growth curves and acid production curves were roughly parallel in the high, medium and low caries and descended in that order. In the agitated tests the total acid production was higher in all series. The lactobacilli grew much less rapidly (with practically no growth in the low caries test) and the streptococcal count fell off more markedly, but in all the general direction of changes were the same. Higher acid production was associated with higher bacterial counts (total bacteria lactobacilli and streptococci). The only relationship between rate of bacterial growth and acid production appeared to be between the rapid growth of streptococci and rapid acid production during the initial hours of the tests." (Authors' summary)

Bibby, Basil G., 1944. USE OF FLUORINE IN THE PREVENTION OF DENTAL CARIES. *Jour. Amer. dent. Assoc.*, 31 (3): 228-236.

The author reviews the literature on the relationship of fluorine to caries-immune and caries-susceptible mouths. A section on the role of saliva in the action of fluorine is included.

Bibby, B. G., 1949. WHAT ABOUT THE SALIVA? *Oral Surg.*, 2 (1): 72-81.

A review of the literature is presented in which the following properties of saliva are discussed: the demulcent effect of saliva, the washing effect, effect in moistening foods, compatibility with tissues, chemical properties of saliva, enzymatic effects, role in defense against injury of mouth tissues, antibacterial effect of saliva, hormonal effects, and selective excretory function.

Bibby, Basil G., Hyman J. V. Goldberg, and Eugene Chen, 1951. EVALUATION OF CARIES-PRODUCING POTENTIALITIES OF VARIOUS FOODSTUFFS. *Jour. Amer. dent. Assoc.*, 42 (5): 491-509.

A "decalcification potential" of foods was calculated as the product of the quantity of carbohydrate foods retained in the mouth and their acid-forming power in saliva.

A considerable overlap occurred among the determinations of decalcification potentials for 96 common carbohydrate foods such as desserts, sodas, candies, bread, cereals, cookies, crackers, fruits, and vegetables. An attempt to correlate the decalcifying potential with caries incidence in hamsters was unsuccessful. Texture, fat, or salt content of foods appeared to influence the decalcifying potential more than did the carbohydrate content. The amount of acid formed in the different salivas varied from person to person. When oil-sprayed cracker was ingested, the salivary acid formed [expressed in ml. of 0.1 N] in 8 individuals ranged from 0.58 to 1.46 after 4 hours, and from 1.51 to 2.94 after 24 hours; with graham cracker, from 0.70 to 1.70 and from 1.61 to 2.96, respectively; and with white bread, 0.69 to 1.68 and from 1.62 to 2.53, respectively.

Bibby, Basil G., and Thomas A. Nevin, 1951a. THE EFFECTIVENESS OF AMMONIATED DENTIFRICES IN REDUCING ORAL LACTOBACILLUS COUNTS. *Jour. dent. Res.*, 30 (4): 503.

In vitro tests, employing the cup plate method in which various ammonium compounds and dentifrices were checked for their ability to prevent acid formation in carbohydrates, showed no essential difference between ammoniated and control (non-ammoniated) cultures.

In vivo tests, 75 young women were divided into 3 groups according to caries activity. Group I used ammoniated tooth paste; Group II, non-ammoniated; and Group III continued their usual dental habits except on the day when saliva samples were collected, when each individual refrained from brushing her teeth. The saliva samples were seeded, then incubated for 4 days; total acid titrations were made and fermentative capacity measured against a glass electrode. After 7 months, the groups were resampled and the process repeated. No significant reduction in lactobacillus counts was produced by ammonium containing dentifrices over either long or short periods of time.

Bienka, E. J., and Cz. Szczepanski, 1936. INFLUENCE DE LA NATURE ET DE LA FORCE DE L'EXCITANT SUR LA QUANTITÉ ET SUR LA TENUEUR EN CHLORURES ET LE pH DE LA SÉCRÉTION SALIVAIRE [The influence of the nature and strength of the stimulant on the quantity, chloride content, and pH of salivary secretion]. *Compt. rend. Soc. Biol. (Paris)*, 123: 32-34.

Tests were made in the dog of the amount and nature of parotid saliva evoked in response to acetic acid, soda, sand, meat, broth, bread, and cream. Two secretory phases were noted: a rapid initial flow followed by a reduced rate of flow as the stimulant is diluted or removed from the mouth. Chemical substances (acids, bases, pulverized foods) produced more saliva at a faster rate than regular foods; among these carbohydrates stimulated a more active secretion than proteins or fats. Less active were mechanical irritants as sand and grit; least effective were extracts as broth or tincture of gentian. The chloride content was found to be higher and the pH lower in rapidly secreted than in slowly secreted

saliva; alkaline stimuli likewise evoked saliva with a higher chloride content and lower pH than acid stimuli. Stimuli having a complex effect, mechanical and chemical, were stronger than analogous stimuli possessing either one or the other effect.

Bier, Otto G., 1932. ACTION ANTICOAGULANTE ET FIBRINOLYTIQUE DE L'EXTRACT DES GLANDES SALIVAIRES D'UNE CHAUVESOURIS HÉMATOPHAGE (DESMODUS RUFUS) [Anticoagulant and fibrinolytic action of the salivary gland extract of a bloodsucking bat (*Desmodus rufus*)]. Compt. rend. Soc. Biol. (Paris), 110: 129-131.

An aqueous salivary gland extract of a bloodsucking bat was found to have anticoagulant and fibrinolytic properties in rabbit blood. A similar extract of a non-bloodsucking bat was inactive when tested in the rabbit blood.

Binet, Léon, 1926. RECHERCHES SUR LE POUVOIR ÉLIMINATEUR DES GLANDES SALIVAIRES [Studies on the eliminating power of the salivary glands]. Presse méd. (Paris), 34 (15): 229-230.

Studies were conducted on the elimination of glucose, uric acid, and urea by the salivary glands.

In all salivary samples, urea and uric acid were constantly present; glucose occurred occasionally. The salivas of two of 34 diabetics contained glucose. The uric acid content was constant and independent of the secretion of saliva. In 50 patients with uremia, the saliva contained from 330 to 1,140 mg. urea/liter saliva against 23 to 164 mg./liter in healthy individuals.

It appears that the urea content of saliva may be of diagnostic value in situations where it is difficult to obtain blood.

Biriukov, D. A., 1928. ASIMMETRIIÂ BEZUSLOVNYKH SLIUNNYKH REFLEKSOV [The asymmetry of unconditioned salivary reflexes]. SBORNIK PO PSIKHONEVROLOGII POSVIASHCHEN. Prof. A. E. Iushchenko (iubileinyi), Rostov on Don, 1928, p. 123-127.

Unequal bilateral rates of secretion of parotid and submaxillary saliva in the dog followed unilateral oral stimulation with a dilute HCl solution. Further study of the asymmetric rates of secretion are described in four dogs, portions of whose buccal mucosa, gums, palate and tongue were stimulated with dilute HCl solution, black pepper powder, ethyl alcohol, and mustard. Simultaneous bilateral oral stimulation resulted in an increased saliva secretion which approached but did not equal the sum of the secretions of each side separately stimulated.

Biriukov, D., 1929. BEZUSLOVNYE SLIUNNYE REFLEKSY CHELOVEKA [Unconditioned salivary reflexes in man]. Fiziol. Zhur. USSR., 12 (4): 365-370.

Unconditioned salivary responses to various food and taste stimulants were studied in 3 children, 9 to 13 years of age. Stimulants were administered in 4 equal portions per minute for 3 minutes; 1-minute salivary samples were collected starting 3 minutes before and continuing 4 to 5 minutes after administration of the stimulant. Results of 110 experiments show that while the amount of secretion was small in all cases, chocolate, meat extract, and 0.5-1.0% citric acid

elicited a greater flow of saliva than milk, meat, 2-4% NaCl, or 3% NaHCO₃. Parotid response was often greater than submaxillary. No appreciable relationship was found between the strength of the stimulant and the resulting salivary response such as occurs in the dog, or between the type of stimulus and the quality of the saliva evolved. The average daily amount of parotid and submaxillary saliva elicited by acids and food was found to remain constant over a long period of time. Salivary responses to food were found to decrease and responses to acid to show no increase at the end of the experimental day, contrary to such findings in the dog. The act of swallowing produced no increase in salivary secretion. Salivary determinations, made before and after a child's visit to the lavatory, showed colon and bladder stimulation to inhibit salivation to a marked degree, confirming previous findings in man and in the dog; greater inhibition was observed in submaxillary than in parotid secretion. Parallel determinations of the viscosity of submaxillary and parotid salivas by observing flow rates through a capillary tube, showed submaxillary saliva to have two to three times the viscosity of parotid; submaxillary saliva averaged from 20 to 27 sec., parotid saliva 8 to 10 sec., and water 5 to 6 sec.

Biriukov, D. A., 1934. O BEZUSLOVNOY SLIUNNOTDELENII NA VODU U CHELOVEKA [On the unconditioned salivary secretion in response to water in man]. Fiziol. Zhur. SSSR, 17 (2): 227-233.

The stimulating action of the ingestion of water on the salivary glands of man was studied in 8 adults. Examinations of the parotid and the submaxillary secretions were made by means of the Krasnogorskii-Iushchenko funnels. This method had been used on several of the same patients during several months to 3 years and proved to be very accurate. The spontaneous secretion was first measured and tested, then the water stimulation administered, either alone, preceded, or followed by another stimulant; finally, the spontaneous secretion retested. The viscosity of saliva was measured by the capillary method, the dry residue determined, and the pH of saliva tested by the colorimetric method. The experiments lasted from 1 to 3 hours each. Each 5-minute sample was examined separately.

Tabulated data show that, contrary to results obtained in animals, water increases salivary secretion in man from several decimals to double or more the amount of spontaneous secretion; moreover, it considerably increases the viscosity of submaxillary saliva [tabulated figures show very great variations in the rate of increase]. In 5 to 10% of the cases only, there was no distinct effect of water on the salivary secretion; however, in these cases a preceding stimulant (acid or glycerin) may have been influential. Besides influences from peripheral conditions, the salivary reaction to water is apparently considerably affected by central nervous reflexes, as revealed by some experiments.

The position of water in the comparative scale of chemical stimulants was investigated: hydrochloric acid, bread, butter, cheese, alcohol, sugar, milk, egg, potatoes, caramel, vine, cucumber, rusks, glycerine, sodium hydroxide, 1% or 5% sodium chloride, 1% potassium chloride, sand, and smoking were tested.

[Tabulated data show a smaller increase in the rate of salivary secretion for water than for any of the other substances; it is approximately double the rate of spontaneous secretion. The increase in viscosity is more than double or triple, greater than for any other substance, showing a great latitude of fluctuations in the data. Second in the scale of viscosity is saliva stimulated by milk; third smoking; fourth, butter. A small increase in viscosity is produced by rusks, bread, potatoes, sand, glycerin and sodium hydroxyde. The remaining substances produce a decrease in viscosity.] Thus, water occupies a very special position as a stimulant of salivary secretion in man. The effect of milk is of all the stimulants closest to that of water.

To elucidate whether this fact is due to the water content or to the taste of milk, special tests were carried out, in which the milk was either diluted and introduced in great quantity, or only a drop of milk was placed on the tongue. Results show that the effect of milk on salivary secretion is due to its water content.

The absence of relationship between the viscosity of saliva and the dry residue percentage observed earlier (Biriukov, 1929,) was fully confirmed in the present tests: the dry residue content in water-stimulated saliva changes little from that of spontaneous saliva.

The influence of the temperature of water was further studied. It was observed that great changes in water temperature, either upward or downward, increase the rate of salivary secretion, while the changes in viscosity [which are considerable in the same subject] show no relation to temperature.

To distinguish secretion arising from a conditioned rather than an unconditioned reflex, "extinction" tests of the water stimulation were made. Tabulated results show that repeated ingestion of water at 2-minute intervals does not lead to a decrease in the salivary reflex, nor to a decrease in the viscosity of saliva. (Kharitonov, 1928, experimenting on the conditioned water reflex in man, obtained complete absence of the reflex after 6 to 8 introductions of water.) These experiments point to the unconditioned character of the water reflex.

The author suggests that the mechanism of secretory changes in the salivary glands under water stimulation, which remains unexplained, is a character acquired in man's recent phylogenetic past.

Biriúkov, D. A., 1934a. DAL'NEISHIE MATERIALY K VOPROSU O FUNKTSII GLAVNYKH SLIÚNNYKH ZHELEZ CHELOVEKA [Further material on the function of the main salivary glands in man]. Fiziol. Zhur. SSSR, 17 (2): 235-241.

Unconditioned salivary secretion in response to food or taste stimuli was studied in several people. The saliva was collected from both parotid and submaxillary glands every 5 minutes and its dry residue content and viscosity measured. Results show a great variability in the basic, spontaneous, saliva of different subjects, especially in regard to viscosity, even in the same subject at different times. The maximum in salivary amount and viscosity is found during the day; early morning and night saliva (during waking) is very thin; during sleep the basic secretion ceases. After meals, the viscosity, and often

the amount of saliva, increases. Thirst decreases the salivary rate, but does not influence the viscosity. Yawning, coughing, and sucking movements increase basic salivation, producing different changes in viscosity. Physical and intellectual work increase the viscosity of basic saliva and decrease the secretion rate. The changes in spontaneous secretion indicate a great mobility and functional variability in the mechanism of human glands. Experiments with various food stimuli and other (citric or hydrochloric acid, sodium hydroxyde, sodium chloride, potassium chloride, glycerin, alcohol) show that neither the viscosity nor the dry residue content of human saliva can serve as indicators of food and defense reflexes.

Biriúkov, D. A., 1936. GLAVNEISHIE FIZIOLOGICHESKIE DANNYE O SEKRETSII SLIÚNNYKH ZHELEZ CHELOVEKA [Main physiological data on the secretion of salivary glands in man]. Fiziol. Zhur. SSSR, 21: 882-883.

A brief review is presented of studies by the author and collaborators (Dorodnitskin, Norkina, Bragintseva) on salivary effects of various stimulants in the parotid and submaxillary glands of 40 persons, using the Lashley-Krasnogorski method. Results contradict the accepted belief of the adaptability of the glands to stimuli. Water elicits a saliva of maximal viscosity. The presence of a continuous salivary secretion in man was revealed. An original method was used for the study of spontaneous secretion. The great lability of the glands, especially of the submaxillary, and their dependence on the higher departments of the central nervous system was shown. Besides the functional peculiarities of human salivary secretion, the specific peculiarities of human salivary mucin were pointed out; the indicator of viscosity does not parallel the amount of salivary mucin or the dry residue content. After elimination of the taste sensation (experiments with gymnema and cocaine) the secretory reaction remains. Secretory changes under the influence of pilocarpine, atropine and adrenalin are not similar in the different glands; pilocarpine evokes a significantly greater parotid secretion than submaxillary. The influences of a low (up to -3°C) or a high temperature (up to 60°C) are manifest in different people by two types of reactions, decreasing or increasing the secretion. These influences are different in the parotid and in the submaxillary glands. The influence of alcohol, administered orally or rectally, differs in the same manner. The changes occurring in basic and in reflex secretions are not parallel. Studies of the indicators (pH, organic and inorganic salivary substances) made in each test, permitted evaluation of the role of innervation and circulation during salivary activity.

Biriúkov, D. A., 1937. K ANALIZU FENOMENA ASIMMETRII SLIÚNNYKH REFLEKSOV [On the phenomenon of asymmetry of the salivary reflexes]. Fiziol. Zhur. SSSR, 22 (1): 62-69.

A study of the asymmetry of the salivary reflex, begun earlier in 5 dogs (Biriukov, 1928) was continued. Stimulation was done by unilateral application of acid [?] [on the tongue]. Experiments were conducted in 20 dogs, which were

fistulated either bilaterally, or unilaterally, with Lashley's cap applied on the non-fistulated side.

All animals showed asymmetrical salivary secretion; the degree of asymmetry varies in the different individuals. It is more marked in the mucous glands than in the parotid. It is most evident after stimulation with an acid of medium concentration [0.3 to 0.4%]. Ipsilateral secretion is stronger than heterolateral, mostly from the mucous glands, which results in a drop of the P/S coefficient [ipsilateral mucous gland secretion increases more than 2.5 times over the heterolateral]. After ipsilateral stimulation followed by heterolateral, the reflex manifests an after-effect, the response being temporarily greater than usual following heterolateral stimulation.

Qualitative examination of the salivas revealed that ipsilateral stimulations by acid increase the dry residue percentage of parotid saliva and decreases the viscosity of the saliva from the mucous glands.

Starvation, which has little influence on food reflexes, produces a decrease in the usual degree of asymmetry.

Bilateral stimulation with acid shows a stronger secretion on the right side in all the glands. This fact was verified with food stimulations.

Conditioned reflexes in response to stimulation by water instead of acid also manifested asymmetry.

The author concludes that the asymmetry in reflexes is a functional phenomenon of the salivary glands which has its origin in the central nervous system.

Biriukov, D. A., 1938. VLIÏÂNIE VYKLIÛCHENIIÂ VKUSOVYKH OSHCHUCHENII (KOKAINOM I GIMNEMOI) NA REFLEKTORNOE SLIÛNOOTDELENIE CHELOVEKA [The influence of elimination of the gustatory sensation (through cocain or gymnema) on the reflex salivary secretion in man]. *Fiziol. Zhur. SSSR*, 25 (1-2): 119-125.

Study was made of the reflectory secretion of all three salivary glands in 11 men in response to chemical or electrical stimuli under exclusion of the gustatory sense. Salivary measurements were determined by means of the Krasnogorskii-Iuschenko method. After a series of preliminary control measurements of the saliva, the oral mucosa and tongue were rubbed and irrigated with 10 to 25 cc. of a 5, 10 or 20% cocain hydrochloride aqueous-alcoholic solution, or with a 6 to 10% infusion of *Gymnema silvestris*, (50 cc. of 2% soda plus 3 to 5 g. pulverized gymnema leaves, kept 5 to 10 days in the thermostat). The salivary measurements were repeated. Gelatine tablets were then given which contained a calculated concentration of either bitter-tasting substances (quinine hydrochloride, gentian, quassin, or magnesium bisulfate), sugar, acids, or water; also, smoking and electrical stimulus were used on two subjects. Three hundred and thirteen measurements of saliva were made after the cocain treatment, 125 after gymnema, and a slightly smaller number of control measurements. The use of gelatine tablets completely eliminated the psychological factor, as the person ignored what taste he was receiving, and proved to be most satisfactory.

The experiments showed the persistence of the reflectory salivary secretion in response to diversely tasting substances after the sensory influence had been eliminated. After cocainisation, the reflexes of all three salivary glands to bitter substances, smoking and electrical stimulation of the tongue decrease 20 to 35%, the reflexes to sugar and acids increase 5 to 30%; the non-stimulated secretion itself is increased. After irrigating the mouth and tongue with gymnema infusion, the reflex salivation to sweets persists.

The results thus confirm earlier findings (Gurevich, 1920; Biriukov, 1928; Shuchgalter, 1936; Dorodnitsyna, 1937) and verify the assumption of the existence of separate morphological elements receiving the reflectory and the gustatory impulses.

Birnkrant, W. B., 1941. THE INFLUENCE OF THE PAROTID GLAND ON BLOOD SUGAR. *Jour. Lab. clin. Med.*, 26 (6): 1009-1011.

The influence of the parotid gland on blood sugar levels was studied in 8 young, male, albino rats. Complete parotidectomy definitely lowered the blood sugar levels temporarily. It is suggested that this drop is due to the removal from the body of a substance in the parotid gland which acts antagonistically to insulin. The presence of approximately one-twelfth the total weight of both glands prevented this fall in the blood sugar level while ligation of part of the parotid gland caused a temporary rise in the blood sugar level.

Bixler, D., and J. C. Muhler, 1958. THE RELATIONSHIP OF FOOD CONSUMPTION AND SALIVARY FLOW TO THE INCIDENCE OF DENTAL CARIES IN THE RAT. *Jour. dent. Res.*, 37 (3): 407-409.

The absence of saliva was found to be associated with a significant increase in dental caries in the rat, in tests of food consumption in 140 Sprague-Dawley strain rats. The animals were divided into four groups, two of which (an unoperated and a desalivate group) received a stock corn cariogenic diet ad libidum, while the other two (an unoperated and a desalivate group) received 60% of the ad libidum diet. Results of the 140-day test showed significant increase in dental caries with desalivation and also a highly significant reduction in caries with reduction in dietary intake.

Blackwell, R. Q., and L. S. Fosdick, 1953. THE AMINO ACID CONTENT OF HUMAN SALIVARY MUCIN. *Jour. dent. Res.*, 32 (5): 639.

Purified mucin, which had been obtained from 10 liters of pooled human saliva, was studied. Two-dimensional paper chromatography and ion-exchange column chromatography indicated that the amino acid content of salivary mucin was similar to that of gastric mucin.

Blackwell, R. Q., L. S. Fosdick, and I. Namajuska, 1954. AMINO ACIDS IN DENTAL PLAQUES. *Jour. dent. Res.*, 33 (5): 649-650.

A study was made, using paper chromatography, of the amino acid constituents of pooled and individual plaque samples of caries-active and caries-free persons. In individual samples from both the caries-active and caries-free groups,

arginine, alanine, aspartic acid, glutamic acid, glycine, and valine were most often found, and leucine and proline were usually present. What was thought to be delta-amino valeric acid was found in all of the caries-active and some of the caries-free. Lysine, taurine, serine, tyrosine, and three unknown spots were occasionally detected.

Lysine, alanine, arginine, proline, aspartic acid, and glutamic acid appeared in greatest amounts in the pooled samples, and tryptophane, phenylalanine, threonine, and histidine were found in small proportions. The pooled samples of the caries-free group contained 0.25% amino acids, while those of the caries-active group contained 0.19%; one-half or 5.76% of the total organic content of the plaque substance in normal subjects consisted of amino acids.

Blackwell, R. Q., and L. S. Fosdick, 1958. THE EFFECT OF PEPTIDES ON ACID FORMATION IN SUGAR SALIVA MIXTURES. *Jour. dent. Res.*, 37 (1): 73.

Pooled caries active saliva was divided into 10 ml. aliquots. To each tube was added 0.1 Gm. of sucrose and 0.1 Gm. of powdered human enamel. In each series, two of the samples were used as controls, while the other samples had known amounts of added test peptide. Each concentration was run in duplicate. The tubes then were incubated at 37.5°C. for 4 hr., centrifuged, and the clear supernatant analyzed for calcium. The difference between the calcium content of the fresh and the incubated samples is a measure of the acid formed during the incubation period. Peptides for the test were secured: (1) from this laboratory by synthesis and by partial protein hydrolysis; (2) from commercial sources, and (3) from numerous educational and industrial laboratories. Most of the peptides studied were without effect, but a number were found to be effective in concentrations as low as 25 mg./100ml. saliva. (Author's abstract)

Blackwood, Janet H., and G. M. Wishart, 1936. THE EFFECT OF SALIVARY ACTIVITY ON THE COMPOSITION OF BOVINE BLOOD. *Jour. Physiol. (London)*. 86 (1): 37-45.

A study of changes in iron and phosphorus components of jugular venous blood following injection of pilocarpine [200 mg.] was made in 6 cows. Five other animals, receiving no injections, were used as controls. The increased activity of the salivary glands resulting from the pilocarpine injection is considered sufficient to produce the changes in the venous blood, the most notable of which is the 16% drop in inorganic phosphorus. Water loss from the blood is attributed to salivary activity as well as to the general effects of pilocarpine on other glandular structures.

Blake, J. C. 1916. DIGESTIBILITY OF BREAD. I. SALIVARY DIGESTION IN VITRO (PRELIMINARY PAPER). *Jour. Amer. Chem. Soc.*, 38 (6): 1245-1260. (Abstr.) *Chem. Abstr.*, 10 (14): 1883-1884.

An in vitro study of the digestibility of polysaccharides (amylose, amylocellulose, amylopectin, and gluten) was made using saliva, commercial ptyalin, Harlick's "diastoid", and takadiastase; the effects of temperature and acidity of the digestive processes were noted. The duration of fermentation, viscosity changes, and

hydrolytic derivatives are compared. Since maltose (an end produce of starch digestion) is optically active, polariscopy was used to follow the digestion rates.

Blake, J. C., 1917. ON THE DIGESTIBILITY OF BREAD. II. SALIVARY DIGESTION OF ERYTHRODEXTRIN IN VITRO. *Jour. Amer. chem. Soc.*, 39 (2): 315-320. (Abstr.) *Chem. Abstr.*, 2 (6): 264.

A continuation of a previous experiment is presented (Blake, 1916) which further describes the enzymatic digestion process of saliva on starch. Rates and temperature effects are given and the effects of enzyme activity on dextrin substrates are discussed. Findings are presented which connect maltose influence with reaction phenomena.

Blatt, Maurice L., Maximilian Kern, and Cecelia M. Kortuem, 1945. A QUANTITATIVE STUDY OF SALIVA GLUCOSE. *Jour. Pediat.*, 27 (1): 71-74.

The glucose content of saliva was determined in 30 caries-free children (15 boys and 15 girls) under 42 months of age. A modification of the Exton-Rose two-dose technique (*Amer. Jour. clin. Path.* 4: 381. 1934.) was used; sugar assays were made by an Evelyn photoelectric colorimeter. Amounts of salivary sugar obtained in a series of four tests were as follows: (1) After fasting, 3 to 27 mg./100 cc.; average 10 mg./100 cc. (2) Thirty minutes after ingestion of 12-1/2 g. glucose, 6 to 124 mg./100 cc.; average 35 mg./100 cc. (3) In a repetition of the second test, 6 to 175 mg./100 cc.; average 51 mg./100 cc. (4) A test of saliva alone, collected 15 minutes after test 3, 6 to 65 mg./100 cc.; average 21 mg./100 cc.

Blood sugar values were concomitantly determined; no constant blood sugar-saliva sugar ratio was observed.

Blayney, J. R., Robert G. Kesel, and Edward C. Wach, 1936. DENTAL CARIES. I. NEW METHOD OF STUDYING BACTERIAL PLAQUE. *Jour. dent. Res.*, 15 (5): 326-327.

"In preparing many ground sections of human teeth, bacterial plaques on enamel surface were frequently observed, as demonstrated by Williams. Beneath some plaques there was caries of enamel; beneath others, all enamel was normal. This showed some bacterial plaques do not produce caries, and suggested hypothesis that types of contained organisms may be different. To study morphology of organisms in plaques, direct smear-preparations were made after all superficial debris removed. Carious plaque always contained either short parallel rods or coccobacilli, described by Bunting as *B. acidophilus* [*Lactobacillus a.* with other associated forms. Non-carious plaques contained any form except typical short rods and coccobacilli, frequently including spirochetes, not associated with carious plaques.

"Susceptibility or immunity to dental caries in 30 young patients studied by two methods: (a) direct smears, and (b) cultures of stimulated saliva for *B. acidophilus*, using Bunting's technic. Comparing results with both methods: agreement in 83 percent of cases. In another study of 62 children, nine years old or younger--using direct smears and culturing material from smears before fixation for *B. acidophilus*--200 negative smears gave negative cultures; 8 positive

smears, gave positive cultures; 7 positive smears gave negative cultures; 5 negative smears gave positive cultures. In 37 cases, in which mouth-washings were cultured--in addition to above--there were 4 positive washings, with negative smears and smear cultures; 22 negative washings with negative smears and smear cultures; and 5 positive washings with positive smears and smear cultures." (Complete paper.)

Blayney, J. R., S. F. Bradel, R. W. Harrison, and Elizabeth S. Hemmens, 1942. CONTINUOUS CLINICAL AND BACTERIOLOGIC STUDY OF PROXIMAL SURFACES OF PREMOLAR TEETH BEFORE AND AFTER THE ONSET OF CARIES. Jour. Amer. dent. Assoc., 29 (13): 1645-1648.

Bacteriological studies were made by removing and culturing the bacterial plaques from proximal surfaces of premolar teeth from the time the tooth erupted into occlusion and made contact with the proximal tooth until a readily demonstrable lesion developed.

From 2 to 4 suitable areas were selected for study in each of 60 patients, ranging in age from 10 to 12 years. The bacterial plaques were removed from proximal surfaces of premolar teeth, avoiding contact with saliva, and were transferred to a small vial containing 2 to 3 drops of sterile veal. The plaques were prepared for culture by trituration, inoculated on a blood-agar or a tomato-agar plate, and then incubated anaerobically for from 3 to 4 days. After incubation, the cultures were examined for colony and cell structure, staining properties, hemolytic activity, acid production, and acid tolerance. The results presented in this paper were limited to the incidence of lactobacillus in the plaques cultured. Other bacterial forms will be reported later.

29% of 284 specimens from the group which were clinically and roentgenographically negative throughout the study, were positive for lactobacilli as compared with 42% of 132 specimens in the group which were positive clinically from the beginning of the study.

Of 524 saliva samples studied, 345 (66%) were positive for lactobacilli. In 58 (32%) cases of negative saliva cultures, lactobacilli nonetheless were cultured from one or more plaques taken at the same time.

The authors state that although a definite increase in the incidence of lactobacilli as a carious lesion developed and progressed was demonstrated, no conclusions concerning the exact relationship of lactobacilli to dental caries could be made.

Blinov, N. I., and Zaslavskii, L. D., 1937. O GRUPPOVYKH FERMENTAKH SLIŬNY [On the group enzymes in saliva]. Fiziol. Zhur. SSSR, 22 (6): 878-884.

Group-specific enzymes were studied in the saliva of people belonging to the A, B, or O blood groups. Schiff's (1931, 1935) and Witebsky's (1933) data were confirmed. It was further observed that saliva lost its inhibiting properties after incubation, and after standing at room temperature for 3 to 4 days. Diluted (1:20) fresh saliva B agglutinated a 50% dilution of serum B in 2.5 minutes; similar 3 day-old saliva agglutinated the serum in 1.5 minutes.

In a second test, the saliva of one B-group subject was collected before breakfast, immediately after the noon meal, and before the evening

meal, and the three salivary samples were incubated at 37°C. for 24 hours. The serum of group A was mixed with equal amounts of all three samples and, for control, with physiological solution, then the rapidity of agglutination with a 5% emulsion of group B erythrocytes was tested by means of the drop method. The salivas collected before breakfast and before the evening meal produced very little delay in agglutination, 45 seconds; with the physiological solution, after 40 seconds. This indicates clearly that the pre-meal saliva contains enough enzyme to destroy all the group substance contained in the saliva. The postcibal saliva gave a rather marked delay in agglutination, showing that the group substance in this saliva remained undestroyed due to lack of enzyme. These facts fully confirm Schiff and Buron's findings.

Investigation was further made, whether the group enzymes of different sources (pepsin, pepsinogen) exert the same action on the group substances. The saliva of A or B subjects was added in different proportions 2.1, 0.5, 0.25, 0.05, and 0.001 drops) to 0.5 cc. of a 1% pepsin solution; the stoppered tubes were incubated for 24 hours; 0.1 cc. of serum B was then mixed with 0.1 cc. of each tube content and the rapidity of agglutination tested by the drop method with a 5% emulsion of group A erythrocytes. In a series of tests the pepsin-saliva mixture in the tubes was diluted several times and an amount of serum equal to the content was added. A parallel control of serum plus physiological solution was always done.

After the mixing of serum B with the non-diluted content of the test-tubes, agglutination, as a rule, did not occur before 20 minutes; 1% of the pepsin solution was destroyed very weakly by the enzymes. The agglutination rapidity of the control was 25 sec.

As the 1% pepsin solution proved unsatisfactory, 0.5 cc. of 0.5, 0.20 and 0.1% solutions were used. Tabulated results show that the addition of a large amount of saliva A (2 drops) does not destroy the group substance of the pepsin, but, on the contrary, blocks the agglutination; addition of small amounts of saliva A (0.01 drop) does not destroy the group substance, but slightly increases the inhibitory action of small pepsin doses, the time of agglutination becoming equal to the sum total, or more, of the agglutination time needed by the particular pepsin solution used and 0.01 drop of saliva. The agglutination of serum B with the mixture pepsin plus 0.01 drop of saliva took place in 3 minutes.

A large amount of saliva B (2 drops) destroys the group substance in pepsin, thus reducing its inhibitory action; small amounts (0.01 drop) of saliva B increase, like saliva A, the inhibitory action of pepsin, although the saliva B alone, in dilution 1:100, does not cause any delay: agglutination by the control serum takes place in 20 to 25 seconds.

In a second series of tests, the same amounts of saliva A or B (2, 0.5, 0.25, 0.125 and 0.01 drops) were mixed with 0.5 cc. of a 1% pepsin solution, and 1 cc. of serum B added to the mixture, the tubes incubated and tested for the agglutination capacity of serum B. As a result, regardless of the amount of saliva or its group, the serum B produced no agglutination in any of the 12 tubes, which proves that the α agglutinin

was completely tied up by the pepsin. But if the content of each tube is mixed in various proportions with the serum B, agglutination follows, depending on which group of saliva was added. The control serum B plus physiological solution produced agglutination after 30 seconds, the same serum with saliva B, in 45 seconds, a slight delay in all 6 tubes, regardless of the amount of saliva added. When the mixture pepsin-saliva A was added to the serum B, there was no agglutination for 10 [min.] the pepsin was not destroyed by saliva A. The author concludes that the group enzyme of saliva A or B react differently to pepsin: saliva A has no action, saliva B destroys pepsin.

The effect of saliva O on pepsin was then tested by the same procedure, substituting saliva O for saliva A or B; 0.5% pepsin was used. The results obtained were identical as for saliva B: after addition of the incubated mixture pepsin-saliva B or O to serum B, agglutination took place after 1 minute; the control produced agglutination after 35 seconds.

After 24-hour incubation of these second-series mixtures [serum B, added to 0.5% pepsin and saliva of different groups and in different dilutions], no agglutination took place in any of the 15 tubes, despite the presence in each of more than 50% of serum B. After addition to each tube of an equal amount of serum B, the following results were obtained: all 5 test-tubes containing saliva A produced no agglutination, the pepsin was not destroyed by the saliva; the 10 tubes containing saliva B or O produced agglutination with only a slight delay; control serum 45 seconds; with saliva B, 1 minute 10 seconds to 2 minutes; control serum 1 minute 30 seconds; with saliva O 2 min. [approx.] to 2 min. 45 sec. This shows that the group enzyme of saliva B and O largely destroys the pepsin.

When the serum B was added in different proportions to the 24 hours incubated mixture pepsin-saliva B or O, a weakening of the inhibitory effect of pepsin could be noticed immediately, as it was destroyed by the group enzyme of the saliva. When the same amount of serum B was mixed with a non-incubated mixture of pepsin and saliva B or O and the tube then incubated for 24 hours, the serum B produced no agglutination.

These data prove that the pepsin, when added to serum B, immediately combines with α agglutinin; against this compound the group enzyme of the saliva is powerless, it can act only on the free remainder of pepsin.

Tabulated results show that small amounts of saliva B (0.01 drop) increase the inhibitory action of pepsin, and the same results were obtained for saliva O. However, pure either B or O saliva, in any dilution, did not delay agglutination. The cause of this phenomenon remains unknown.

Tests with a 5 to 0.1% peptone solution were then made. Stronger solutions of peptone are necessary than for pepsin, because of the weaker inhibitory action of peptone. The tables of these results were almost completely identical with those for pepsin. Only one example is therefore given: to a mixture of 0.5 cc. of a 5% peptone solution and different dilutions of saliva A, B or O serum B was added after 24 hours of incubation: with 2 drops of saliva A there was no agglutination, with 2 or 0.01 drops of saliva A

there was agglutination in 30 sec., with 2 or 0.01 drops of saliva B, or saliva O there was agglutination in 30 seconds. The control serum plus physiological solution agglutinated in 25 seconds.

These data show that the group enzyme of the salivae O and B destroy the group substance of peptone as well as pepsin, while the enzyme of saliva A has no action on peptone or pepsin.

Blinova, A. M., 1940. K VOPROSU O ROLI KROVOSNABZHENIIA V DEIATEL'NOSTI PODCHELIUSTNOI I PODZHELUDOCHNOI ZHELEZ [Concerning the role of blood supply in the function of the submaxillary and the pancreatic glands]. Fiziol. Zhur. SSSR, 28 (5): 542-551.

Seventy experiments were made on dogs under morphine and ether-chloroform anesthesia. The function of the submaxillary gland with reduced blood supply was studied by clamping off either the submaxillary or the carotid artery. The submaxillary glands were cannulated and salivary secretion elicited through faradic stimulation of the chorda tympani. For the study of glandular function with increased blood supply, either the diaphragmatic abdominal aorta or the thoracic aorta below the subclavian branching was clamped off 5 min. before salivary stimulation and remained so for 10 min. The renal veins were clamped off to prevent increased adrenaline influence on the salivary glands. To determine the blood supply flowing out of the submaxillary glands, all the veins arriving at the exterior jugular, except the submaxillary vein, were clamped off and the blood from the jugular vein was allowed to flow out through a T-shaped cannula. To eliminate sympathetic influence, the upper neck ganglion was removed. Control experiments were made where the chorda was stimulated during 5 to 6 hours without inhibition of the blood flow.

The results obtained showed that a small reduction in blood flow may not affect the quantitative and qualitative salivary reaction in response to secretory nerve stimulation. The secretory reaction is diminished only after a sharp blood reduction. A decrease in secretion always corresponds to a qualitative change in the saliva, i.e. a percentage increase of the organic matter. The total organic content of this saliva remains, however, below the rate secreted by normally blood-irrigated glands; the inorganic content varies. The author sees in this a proof that the disturbance in blood supply affects not only the production of liquid saliva, but that of its organic substance as well.

The observed changes in secretory reaction have an after-effect, and restoration is a very gradual process.

Bliss, Sidney, 1937. THE CAUSE OF SORE MOUTH IN NEPHRITIS. Jour. biol. Chem., 121 (2): 425-427.

The action of urease in the tartar of teeth in producing ammonia in the saliva was studied in normal and nephrectomized dogs. A small glass capsule (1 cc.) was clamped to the inner surface of the lip of a normal dog anesthetized with repeated injections of Nembutal over a period of 8 hrs. Three capsules were applied to the same dog at the same time: one contained physiological saline; another, ammonium sulfate; and the third, ammonium hydroxide. Concentrations of the ammonium

salts used were such as to be equivalent to the amount of ammonia that would be liberated from the urea into saliva when the blood non-protein nitrogen was at a level of 300 mg. per 100 cc. The tissue area in contact with the saline solution was not damaged; ammonium sulfate caused a slight reddening; ammonium hydroxide produced an area of severe damage, evident a week later.

Saliva dripping from the tongue was collected from a doubly nephrectomized dog. The blood urea nitrogen was found to be 238 mg./100 cc. and the salivary urea nitrogen, 105 mg. On 3 successive days the saliva showed pH values of 8.8, 8.3, and 7.9. The alkalinity of the saliva was sufficient to liberate free ammonia; when 2 cc. saliva were added to a solution containing 1 mg. of nitrogen as ammonium sulfate, 33% of the nitrogen was liberated as ammonia.

A pooled sample of tartar from the teeth of 50 normal dogs was suspended in warm water; the pH was 6.97. Since ammonia can be liberated at a pH above 5, it was concluded that urease in the tartar of teeth acts upon the urea of saliva to produce ammonia. In nephrectomized dogs the concentration of urea is high, and enough ammonia is formed by the enzymatic hydrolysis of urea to produce ulceration. Alkalinity of saliva contributes to the liberation of the free ammonia.

Blix, Gunnar, 1936. UBER DIE KOHLENHYDRATGRUPPEN DES SUBMAXILLARISMUCINS [On the carbohydrate groups of submaxillary mucin]. Hoppe. Zeylers Zeitschr. f. physiol. Chem., 240 (1/2): 43-54.

"The submaxillary mucin contains very insignificant quantities of hydrolyzable sulfuric acid. Mucoitin-sulfuric acid therefore cannot even be considered as a prosthetic group. Two different carbohydrates could be isolated from submaxillary mucin, one of which could be obtained in crystallized form. This carbohydrate, which apparently is absorbed (20-25%) by mucin, is composed of: 1. hexosamine, 2. an acid grouping, whose nature could not yet be determined, but which is not a hexonic acid, and 3. two acetyl groups (pro. Mol hexosamine). In contrast to a series of glucoproteids examined, the substance [carbohydrate] yields a strong red coloration with the p-dimethyl-amino-benzaldehyde reagent of Ehrlich, even without preliminary treatment with alkali. The second carbohydrate is a neutral substance and contains one molecule hexosamine for every two molecules hexose (probably mannose). Consequently, it is of the same nature as the carbohydrate isolated by Levene and Mori from egg white and by Rimington from serum protein. It occurs in amounts of approximately 5% in submaxillary mucin." (Author's summary, translation.)

Blix, G., E. Lindberg, L. Odin, and I. Werner, 1955. SIALIC ACIDS. Nature, (London) 175 (4451): 340-341. Feb 19, 1955.

A report is made of sialic acid, a crystalline reducing acid first isolated from bovine submaxillary mucin. Qualitative reactions indicate that the acid, or substances closely related to it, occurs in most epithelial mucins. Crystalline substances reacting like the acid have now also been isolated from porcine, ovine, and equine submaxillary mucin. None of these are identical with any of the others. Elementary analysis indicates the probable composition of bovine sialic

acid to be $C_{13}H_{23}NO_{11}$, porcine $C_{11}H_{19}NO_{10}$, and ovine, $C_{11}H_{19}NO_9$. The sialic acid molecule apparently has a branched carbon chain structure, with an α -hydroxy and possibly an aldehyde group, as well as either acetyl or glycolyl groups present.

Bloch, Oscar, Jr., 1937. ATTEMPTS TO DEMONSTRATE VIRUS-NEUTRALIZING SUBSTANCES IN SALIVA AND SERUM FROM MUMPS IMMUNES. Proc. Soc. exper. Biol. Med., 37 (1): 134-137.

The virus-neutralizing properties of human and monkey (*Macacus rhesus*) salivas were studied in order to analyze the mechanism of active immunity in experimental mumps.

Mumps-immune and "normal" (non-immune) monkeys were anesthetized (Nembutal, 30 mg. per kg.) saliva flow was stimulated by injections of pilocarpine hydrochloride (one mg. per kg). After centrifugation and, in some cases, filtration of the saliva, a saliva-virus mixture was made consisting of equal parts of saliva and of a 20% saline suspension of mumps-infected glands. This produced a tissue concentration of 10%, which had been found sufficient in 2 cc. amounts to cause mumps. The virus-saliva mixture dosage was 3.5 cc. Similar mixtures were prepared with human saliva.

The virus-saliva mixtures were generally kept at 37° for 2 hours before injection to permit antibody-virus combination.

Tests were made on normal monkeys by injecting the virus-saliva mixture into one parotid gland and a normal fluid into the other. A difference in "takes" of the two glands with respect to time of onset and size of gland swelling, denoted the presence or absence of virus-neutralizing substances in the injected saliva.

Results of the experiments were inconclusive and no evidence of presence of any considerable amount of antiviral substance in monkey or human saliva was noticed.

Blokh, E. L., 1939. RABOTA OKOLOUSHNYKH I PODCHELIUSTNYKH ZHELEZ U KRUPNOGO ROGATOGO SKOTA [The function of the parotid and submaxillary glands in cattle]. Fiziol. Zhur. SSSR, 27 (2): 200-210.

Parotid and submaxillary salivation in response to oats, bran, oil cake, beets, and hay was studied in two 3 year-old fistulated bovine cattle. Determinations were made of the secretion rate, alkalinity, dry residue, organic matter and ash content in each one-minute sample, collected 2 to 3 hours after the morning meal. Continued parotid salivation and absence of submaxillary salivation were noted; 24.5 L. of parotid saliva was secreted in 24 hours. This secretion was not uniform, increasing during a feeding and decreasing sharply after it to rise again 4 to 6 minutes later; submaxillary salivation continued for a time after the food was eaten. The total salivary response, but not the rate of flow was higher to dry food than to moist due to the longer action of eating; the largest amount of parotid saliva was evoked by oil cake. Salivary response is also dependent on the reactivity of the gland, as equal portions of a given food produced wide variations in salivation rate. Parotid secretion was greatest on the side of mastication while eating rough foods; it also increased on drinking water, dropping for 4 to 5 minutes after the ingestion before again increasing. Drinking of

water temporarily evoked submaxillary salivation. Rumination increased parotid salivation but elicited only a few drops of submaxillary saliva at the end of the rumination. Conditioned submaxillary salivation, stimulated by sight of food or entry into the experiment room, persisted for 1.5 hours while parotid salivation was inhibited from one half to one third; experiments conducted during the period of lowest parotid salivation produced an increase in salivary flow after conditioned reflex stimulation. Neither the organic matter nor alkalinity of submaxillary or parotid saliva were influenced by stimulation with the various foods or by rumination. Teasing with food considerably increased the organic matter, ash content, and alkalinity of both salivas; these changes persisted during a subsequent feeding.

Bloomfield, Arthur L., 1919. THE FATE OF BACTERIA INTRODUCED INTO THE AIR PASSAGES. I. Johns Hopkins Hosp. Bull., 30 (345): 317-322.

Solid masses of growth of *Sarcina lutea*, from plain agar slants, were swabbed on the tongue, nasal mucosa, or tonsillar crypts of human subjects. At regular intervals cultures were taken by the use of a heavy platinum loop and direct transfer was made to agar plates.

The results of the experiments indicate a remarkable efficiency of the mechanism of the upper air passages to dispose of the organisms. Only a few colonies of *S. lutea* could be recovered from the tongue after 10 minutes, and practically none at the end of an hour. At the end of an hour the organisms had disappeared from the tonsillar crypts in 2 out of 4 cases, and none could be recovered in 24 hours. They disappeared more slowly from the nasal mucosa but only in 1 out of 5 cases could a few colonies be recovered after 24 hours.

The author states that, of the possible factors active in effecting this disposal of *S. lutea*, the reaction of the mouth secretions, mechanical cleansing, and the mouth bacteria play little if any part, but that the saliva and mouth secretions exert a prompt and marked bactericidal effect.

Bloomfield, Arthur L., 1919a. FATE OF BACTERIA INTRODUCED INTO THE UPPER AIR PASSAGES. Amer. Rev. Tubercul., 3 (9): 553-567.

Sarcina lutea was introduced into the mouth or upper air passages of normal individuals, and swabbings were taken immediately, and at 10-minute, 1-hour, 18-hour, and 24-hour intervals. When *S. lutea* was swabbed on tongue, it disappeared rapidly with a few colonies recovered at the end of 10 minutes, practically none at the end of 1 hour; simultaneous cultures made from pharynx yielded only a few colonies at the end of 10 minutes. When *S. lutea* was swabbed on nasal mucosa, it persisted longer than on tongue but only in 1 of 5 cases could a few colonies be recovered after 24 hours; only a few colonies could be recovered from simultaneous nose-pharynx cultures. When *S. lutea* was introduced into tonsillar crypts, it could not be recovered after 24 hours; in 2 of 4 cases, *S. lutea* had disappeared at the end of 1 hour.

Reaction of the mouth secretions, effect of mechanical cleansing and bacterial inhibitory effects of mouth secretions were studied. Saliva and mouth secretions of individuals inoculated with *S. lutea* showed a pH range from 5.9 to 7.6 (*S. lutea* grew with equal luxuriance in plain

agar tubes with pH 5.9 to 8.0). Thorough rinsing of the mouth with sterile salt solution reduced the bacterial count in no case more than 50%. Cultures indicated that saline suspensions alone or containing mixed oral flora failed to exert an inhibitory effect on *S. lutea*, whereas saliva alone in culture with *S. lutea* was rapidly bactericidal, the number of microorganisms decreasing so rapidly that only an occasional microbe was observed after 1 hour and none after two hours. The author considers the 1-4 day period which elapsed before colonial growth appeared to be further evidence of the inhibitory effect of saliva.

Bloomfield, Arthur, 1920. III. THE FATE OF INFLUENZA BACILLI INTRODUCED INTO THE UPPER AIR PASSAGES. Johns Hopkins Hosp. Bull., 31 (347): 85-89.

The 24-hour growth of *B. influenzae* [*Hemophilus i.*] on an agar slant was deposited on the tongue, nasal septum, naso-pharynx, or tonsillar crypts of human subjects. Cultures at various intervals were made by scraping the site of inoculation with a platinum loop -- or a cotton swab in the case of the naso-pharynx -- and spreading the material directly over two agar plates.

B. influenzae completely disappeared from the sites within one to two days and did not leave any pathological changes. Instances of isolation of *B. influenzae*, later than 24 hours after inoculation, were shown to be different strains from any of the 3 originally used in inoculation.

Influenza bacilli which were suspended in saliva for 24 hours at 37°C. were no longer viable.

The author felt that the disappearance of influenza bacilli from the upper air passages is probably due to the combination of an unfavorable environment with the mechanical flushing processes at work in these regions.

Bloomfield, Arthur, 1920a. THE FATE OF BACTERIA INTRODUCED INTO THE UPPER AIR PASSAGES. II. *B. COLI* AND *STAPHYLOCOCCUS ALBUS*. Johns Hopkins Hosp. Bull., 31 (347): 14-19.

Masses of 24-hour growth of *B. coli* [*Escherichia coli*] and of *Staphylococcus albus* [*Micrococcus pyogenes* var. *albus*] on agar where swabbed on the anterior half of the tongue, the mucosa of the nasal septum just posterior to the vestibule, or a tonsillary crypt of human subjects. Sodium taurocholate (5 to 10%) was added to the plain agar and served to inhibit the usual throat flora and to make detection of *B. coli* easy.

The organisms disappeared quickly, usually completely within 24 hours. The removal was different from that previously found in similar experiments with *Sarcina lutea* (Bloomfield, 1919m). In the current experiments the organisms were probably removed mechanically more rapidly than they multiplied rather than by any bacterial action of the saliva or mouth secretions. Inert particles (kieselguhr and rotten earth) disappeared at about the same rate of speed as did the bacteria.

Bloomfield, Arthur L., and J. G. Huck, 1920b. THE FATE OF BACTERIA INTRODUCED INTO THE UPPER AIR PASSAGES. IV. THE REACTION OF THE SALIVA. Johns Hopkins Hosp. Bull., 31 (350): 118-121.

The pH of mixed saliva of 52 clinically normal individuals was studied and the effect of various factors such as food, smoking, gargles, acid, and alkali on the pH value was included. The pH reaction of saliva in disease was also studied.

Bloomfield, Arthur L., 1922. THE MECHANISM OF ELIMINATION OF BACTERIA FROM THE RESPIRATORY TRACT. *Amer. Jour. med. Sci.*, 164 (6): 854-867.

The buccal cavity is protected against invasion by foreign pathogenic bacteria mainly by a process of flushing, as in swallowing. The bactericidal or bacteriostatic action of saliva is also considered important. It is suggested that the pH of most salivas, 6.0 to 7.3, is more acid than that found to be optimum for the growth of pathogenic bacteria. Another possible factor may be an antagonistic action against foreign bacteria by the normal oral flora.

Bloomfield, Arthur L., 1922a. THE DISSEMINATION OF BACTERIA IN THE UPPER AIR PASSAGES. I. THE CIRCULATION OF FOREIGN PARTICLES IN THE MOUTH. *Amer. Rev. Tubercul.*, 5 (11): 903-914.

Charcoal particles were used to simulate bacterial distribution in the oral cavity during normal activity of the mouth. The free flow of saliva from the parotid gland was found to sweep the particles over the tongue and into the sublingual space.

Bol, J., 1937. DE ZELFREINIGING VAN DEN MOND [The self-cleansing of the mouth]. *Nederland. Tijdschr. Voor Geneesk.*, 81 (22): 2496-2505. In Dutch, with French and English summaries (p. 2505).

The secretion rate and composition of saliva before and at various periods up to 50 minutes after eating sour apples were determined in 53 subjects. The amount of saliva and both the alkali concentration and the total alkali secretion per minute generally, increased after chewing the apple. The increased alkali secretion of the saliva is considered to neutralize the fruit acids and contribute to the cleansing of the mouth cavity in a more efficient manner than that effected by the application of alkaline dentifrices.

Boldyrev, V. N., 1907. USLOVNYE REFLEKSY I SPOSOBNOST' IKH K USILENIU I OSLABLENIU [The conditioned reflexes and their capacity to increase or decrease in strength]. *Kharkov Med. Zhur.*, 4 (6-7): 1-23.

Thorough examination was made of the mutual relationship between the unconditioned and the conditioned reflexes in the dog under various circumstances. The secretion of the salivary glands was used as indicator, since laboratory observations have proved that any occurrence capable of stimulating an animal can become the elicitor of salivation. Experiments were conducted in several dogs with fistulated submaxillary and parotid ducts, in 3 to 6 day periods with several [1 to 6] days intervals between the periods. The stimulant used was a 2% sodium solution or 0.5% hydrochloric acid introduced per os. Tabulated results show the amount of saliva secreted in 5 to 7 minutes, in most cases, for both the parotid and the mucuous glands.

During repeated stimulation every 10 to 30 minutes an increase in the salivary reflex can be observed with each new stimulus. If the same

tests are made daily, with 10 repetitions of the same stimulant, the salivary rate increases with great regularity each day from the first sample to the last and from one day to the next, so that at the end of a series of experimentation, the amount secreted in 5 to 7 minutes may become 2 and 3 times the original values. The conditioned reflex created on the basis of soda and hydrochloric acid, obtained from time to time during the intervals between periods of experimentation, showed the same increase at the end of each day. The assumption is advanced that the increase observed in unconditioned reflex salivation is due to the conditioned reflex which adds itself to the unconditioned proper, as the unconditioned-reflex in itself is very constant and uniform. The increase of the salivary reflex in response to repeated stimulation with inedible substances has been studied in detail in previous articles (Boldyrev, 1905 and 1906).

If, instead of inedible substances, food stimulants are used (meat powder, rusks, bread, sausage or milk) at short intervals (4 to 10 min.) without interruption, in equal amounts and during the same periods of time, the opposite results are obtained: the rate of salivary secretion decreases continuously and abruptly, so that, at the end of the experimentation series, the amount becomes 75 or 50% of its original value. If the feeding is repeated less often, no decrease in the secretion rate is observed, the level of secretion fluctuating slightly around the same values.

Qualitatively, after repeated feeding in rapid succession, the saliva becomes thinner and loses its viscosity. The conditioned reflexes, obtained at the sight of the food between periods of experimentation, decrease only if the stimulation is repeated at brief intervals. The conditioned reflexes which precede or follow the feedings, are strongest at the beginning of the day of experimentation. At the end of the test with rapidly repeated feedings, small but rather stable secretion rates are obtained. The assumption is therefore made that the decrease in the so-called unconditioned reflex rate occurs at the expense of an added conditioned secretion, which alone is subject to change. Thus the "unconditioned" salivary reflex is a combination of both, the unconditioned and the conditioned reflexes, the one being stable, the other tending toward extinction.

The following example confirms this hypothesis. After the salivary secretion rate had been decreased by rapidly repeated feedings, an interruption of 30 to 40 or 50 min. was made, then the feeding resumed as before. The first salivary sample showed again an increased rate, while the following samples dropped much faster than before. Since the conditioned reflex in response to food has the property of increasing after a prolonged interruption, which capacity may be used in the restoration of an extinguished reflex, these results corroborate the author's assumption.

Experiments were then made with continuous feeding of equal portions every 30 seconds during 6 to 10 or 15 min.; especially selected, dogs with great eating capacity were used. The salivary samples were examined for each minute. Results showed a continued decrease in the secretion rate. If a prolonged interruption was made, followed by a renewed intensive feeding, again greater values appeared in the first minutes,

followed by a decrease. The decrease in salivary secretion in the above-mentioned cases cannot be ascribed to gland exhaustion for the following reasons: 1. the drop in secretion rate corresponds to an increase in the case of inedible substances; 2. in the repeated feeding of dogs with resected digestive tube, the salivary secretion does not diminish, but keeps increasing; 3. if, after repeated feeding with one stimulant, attaining at a low secretion level, the type of food is changed, the secretion rises immediately to the values obtained for this food at the beginning of an experiment, as if no previous feeding had taken place.

Exophagotomy was performed in 4 dogs and both ends of the resected tube exposed to the surface of the body; after recovery, the dogs were again tested by rapidly repeated feeding. Though they would keep swallowing for a long time, their salivary secretion rate did not decrease, but kept increasing. The author suggests that, since no food can drop into the stomach, the inhibiting reflexes, which radiate from the intestine to the salivary glands after several food portions have been absorbed, are not elicited, and the salivary secretion remains unchecked.

If, after repeated feeding and attainment at a low secretion level, a different type of food is given several times before reverting to the former substance, the secretory activity of the glands can be improved considerably and the total output of saliva increased.

In animals which have been starved for a long time, the salivary secretion shows less tendency to drop after rapidly repeated feedings; in animals which were fed recently, the salivary secretion rate drops very rapidly.

After food stimulations, the variations in salivary secretion rates are more regular in the mucous glands than in the parotid; the opposite occurs after strong stimulation with inedible substances (soda, acid, etc.). In general, the reaction to foods is stronger in the mucous glands; to inedible, substances, response is stronger in the parotid.

Bordet, Marguerite, 1928. CONTRIBUTION A L'ETUDE DU LYSOZYME [Contribution to the study of lysozyme]. *Compt. rend. Soc. Biol. (Paris)*, 99 (29): 1252-1254.

Canine saliva possesses a marked lytic power. One drop of such saliva added to a dense emulsion of *Micrococcus lysodeikticus* completely cleared the microbial suspension. The lytic power of human saliva was found very weak or absent.

Borelli, L., and G. Messines, 1909. LA REAZIONE WASSERMANN CON VARI LIQUIDI ORGANICI E COL SERO DEI VESICATORI. NOTA PREVENTIVA [The Wassermann reaction with various organ fluids and with blister serum: a preliminary note]. *Gior. della Accad. di Med. Torino*, (4) 15 (4-5): 127-129.

Attempts to obtain a positive Wassermann reaction with saliva of syphilitic patients failed even when large amounts (up to 1 cc.) of saliva were used and the saliva was previously heated to 52-55°C. (p. 127).

Borisovskii, V., and N. Vvedenskii, 1930. POVERKHNOSTNAIA OKTIVNOST' SLIUNY CHELOVEKA [Surface activity of human saliva]. *Zhur. eksper. Biol. Med.*, Moskva, 14, Ser. A, (38): 19-23.

An investigation was made of salivary surface tension at various temperatures, of the temperature coefficient, of the total surface energy and relative adsorption of human parotid saliva. Reversibility of the temperature curves of salivary surface tension was noted as an indicator of the nature of the surface-active substances in solution. Biscuit or a 0.1% HCl solution were used to stimulate the saliva, which was collected from the capped duct and either cooled or used immediately to determine the temperature curve of surface tension. Determinations at temperatures from 0° to 80°C were made of amylolytic activity and surface activity of saliva elicited by food and acid; reversibility of the temperature curve was determined from 60° to 0°C. Results show that acid-stimulated saliva is poor in surface-active substances, the surface-tension temperature curve usually corresponding to that of inactive solutions; the temperature coefficient and the total surface energy show little change with temperature; the relative adsorption curve does not reach a maximum; absolute surface tension values at the solution-vapor boundary at 20°C vary from 66.41 to 70.99 erg/cm² (water, 72.75 erg/cm²). Reversibility of the acid-stimulated saliva was not complete due to albumin precipitation, occurring from 60° to 80°C, which acts directly to lower the tension and indirectly by carrying down other surface-active substances. Food-stimulated saliva is richer in surface active substances and has a surface-tension temperature curve typical of such substances; total surface energy reaches a maximum; and the relative adsorption curve rises with temperature; the absolute surface tension values at 20°C vary from 66.23 to 69.89 erg/cm²; while the absolute values show some variation, the type of temperature curve is characteristic of food and defense reflex salivation. The surface tension curves of food-stimulated saliva are not reversible; the salivary dry residue is usually less than in acid-stimulated saliva. The greater or lesser surface activity of a liquid may be related to its enzymatic power. As food-stimulated saliva contains more enzyme than acid-stimulated saliva (in which enzyme was destroyed during heating), it should contain a more saturated adsorption layer. This point, which is important in starch digestion, will be further investigated.

Borisovskii, V., and N. Vvedenskii, 1930a. PASSIROVANIE DEISTVIA FERMENTOV. O VLIIANII ORGANICHESKIKH ZHIRNYKH KISLOT NA RASSHCHEPLENIE KRAKHMALA Blocking of enzyme action. On the influence of organic fatty acids on the splitting of starch. *Zhur. eksper. Biol. Med. Moskva*, 14 Ser. A (38): 24-29.

The effect was studied of certain surface-active organic acids on amylase activity of human parotid saliva. The biscuit-stimulated saliva was collected from the capped duct and cooled; the enzymatic activity was tested for control in each experiment, in some cases with addition of acids. Five cc. samples of the saliva were diluted 1:50 or 1:100 depending on its enzymatic power. Results show that some acids, as hydrochloric, acetic, or lactic, inhibit amylolysis in human saliva even at weak concentrations; others have no such effect even at high concentrations. Investigations showed the molecular adsorption of surface-active fatty acids, as caproic, butyric, or heptylic, on the micellar

surface of starch. As a result of this adsorption a monomolecular layer is apparently formed which inhibits amylase activity.

Borissovsky, V. and N. Wvedensky, 1930b. PASSIVIERUNG DER FERMENTWIRKUNG. UBER DEN EINFLUSS ORGANISCHER FETTSÄUREN AUF DEN SPALTUNGSPROZESS DER STARKE DURCH DIE FERMENTE DES MENSCHLICHEN SPEICHEL [Inhibition of enzyme activity. The effect of organic fatty acids on the decomposition of starches induced by the enzymes of human saliva]. Biochem. Zeitschr., 219 (1-3) 72-78.

Experiments were carried out with 5 cc. saliva collected through a siphon from the human parotid. The saliva samples were diluted in the ratio of 1:50 of 1:100, depending on the enzyme action of the starches. The amylolytic activity was examined by Wohlgemuth's method. A series of tests were carried out by adding various fatty acids, such as caproic acid, butyric acid, valeric acid, and heptyl acid. All these boundary surface-active acids of the fatty series had an inhibitory effect on the decomposition of starches of the saliva. These acids were adsorbed by the amyloid-nucleus forming on its surface a monomolecular adsorbed layer, inhibiting the activity of the enzyme. The effect of boundary surface-active acids on the process of amylolytic decomposition of the saliva can be only considered as passive.

Borissovsky, Viktor, and Nikolaus Wwedensky, 1930c. OBERFLÄCHENAKTIVITÄT DES MENSCHLICHEN SPEICHEL [Surface activity of human saliva]. Biochem. Zeitschr., 219: 79-86.

A study is reported of the surface activity of stimulated human saliva. The temperature curve of saliva elicited by a 0.1% HCl solution was found to differ from that of saliva obtained after food (cracker) stimulation. The acid-stimulated saliva had a temperature curve of surface tension characteristic of inactive solutions, while food-stimulated saliva had a temperature curve characteristic for interfacial tension solutions. The surface tension of human saliva under certain conditions and in different persons can show relatively significant fluctuations while maintaining the type of temperature curve characteristic of the manner of salivary stimulation.

Boston, L. Napoleon, and Louis Winfield Kohn, 1917. THE SALIVA IN DIABETICS. New York med. Jour., 195 (11): 497-502.

A review is presented on the literature on factors (i.e., age, sex, temperature, etc.) influencing salivary composition.

The pH and amylolytic power of salivas from 10 healthy and 20 diabetic persons were determined. No marked difference in pH (determined by titration) occurred between the salivas of the diabetics and the normal individuals. Of the diabetics, one saliva was alkaline in reaction; all others were feebly acid. All 10 of the normal salivas were acid in reaction. Using a modification of Wohlgemuth's method of determining the diastatic activity of saliva [cf. Wohlgemuth, 1908m], wide variations were observed in both the normal and the pathological cases. In the normal saliva, the high points of diastatic activity varied from 50-200 (measured as the number of cc. of a 1% starch solution which could be converted into dextrin by 1 cc. of saliva). In the diabetics,

the diastatic activity varied from 75 to 500. The authors indicate their doubt that the high values in the pathological cases are constant features but recommend further investigation.

No relationship was observed between the diastatic power in the saliva and the quantity of sugar in the urine.

In the saliva of normal individuals, no marked difference was observed in the quantities of N/100 NaOH necessary to neutralize one cc. of saliva. The actual quantities of acid in each cc. of saliva ranged from .0146% to .0219% in the normal specimen; in diabetics, acid values (excluding the alkaline specimen) varied greatly, from .00365% to .0765%. Although these acidities exceed those which are supposed to retard the diastatic activity (.03%), the activity sustained itself well. 47 refs.

Boucheron, 1896. EXCRÉTION DE L'ACIDE URIQUE PAR LA SALIVE CHEZ LES URICÉMIQUES. [Excretion of uric acid by way of saliva in persons with uricemia]. Compt. rend. Soc. Biol. (Paris), 48 (15): 454-456.

Murexide tests showed the presence of uric acid in the saliva of persons suffering from malfunction of the kidney.

Bouckaert, J. J., and Jeanne Hurynowicz, 1927. L'ION CALCIUM, CONDITION D'EXCITABILITÉ DES NERFS SÉCRÉTEURS (corde du tympan) [The calcium ion, a condition for the excitability of the secretory nerves (chorda tympani)]. Compt. rend. de Soc. Biol. (Paris), 97 (22): 356-358.

Intravenous administration of 15 cc. of a 4% sodium fluoride or of sodium oxalate solution in 0.9 saline to a chloralosed dog caused a marked drop in quantity of submaxillary saliva elicited by electrical stimulation of chorda tympani. Similar injection of 25 cc. of a 39.6% solution of NaCl also caused a marked but transitory drop in submaxillary salivation produced by chorda tympani stimulation. The lessening of the chorda tympani excitability is thought to result from the drop in calcium ion concentration brought about by the salts introduced into the blood stream.

Bourquelot, Em. 1887. SUR QUELQUES POINTS RELATIFS À L'ACTION DE LA SALIVE SUR LE GRAIN D'AMIDON [On some points relative to the action of saliva on starch grains]. Compt. rend. Soc. Biol. (Paris), 39 (1): 13-16. Starch is hydrolyzed by saliva faster than by distilled water; the hydrolyzing action of saliva, due to diastase, diminishes at about 58°C and is completely lost on heating to ±71°C.

Bourquelot, Em., 1910. SUR L'INVERTINE DE LA SALIVE. A PROPOS D'UNE NOTE DE M. MARCEL LISBONNE [On the invertin of saliva. Regarding a note of Marcel Lisbonne]. Compt. rend. Soc. Biol. (Paris), 68 (23): 1096-1097.

The experiments of M. Lisbonne confirm the conclusions of Bourquelot published in 1884, that inversion of cane sugar by saliva is brought about by invertin of microbial origin. Bourquelot has found that saliva filtered through porous earth does not invert cane sugar; unfiltered saliva, on the other hand converts cane sugar, but is contaminated with bacterial growth.

Boxer, G. E., and J. C. Rickards, 1952. DETERMINATION OF THIOCYANATE IN BODY FLUIDS. Arch. Biochem. Biophys., 39 (2): 292-300.

A method is described for the determination of thiocyanate in plasma or serum, cerebrospinal fluid, urine, gastric juice, and saliva, based on the quantitative oxidation of thiocyanate to cyanide under mild conditions.

The deproteinized salivary sample (0.025-0.3 ml.) is diluted with 10 ml. of water and introduced into an oxidation tube which is connected with an alkali trap. One ml. of 1.0 N H_2SO_4 + 1 ml. of 0.01 M permanganate is also introduced into the oxidation tube via a funnel with a stop-cock, so arranged that the system may be closed and the inflow of substances prevented.

Oxidation is allowed to proceed for three minutes, and gas under pressure is then used to force stannous chloride into the oxidation tube, as well as aerate the evolved cyanide into the alkali trap. The system is flushed with nitrogen (500-750 ml./minute) for 45 minutes to completely sweep the apparatus and force all of the cyanide into the alkali. The cyanide contained in the base is then determined colorimetrically with the aid of calibrated and suitably diluted solutions of ammonium thiocyanate containing from 0.025 to 0.400 g. of cyanide.

The cyanide formed by minor side reactions was determined by investigational evidence to be insignificant.

Boyd, W. C., and Lyle G. Boyd, 1934. GROUP SPECIFICITY OF DRIED MUSCLE AND SALIVA. Jour. Immunol., 26 (6): 489-494.

Both fresh saliva and saliva dried and stored for 3-4 hours were examined for the presence of agglutinogens A, B, M, and N. Testing fluids of Landsteiner and Levine (Jour. exper. Med., 47: 757. 1928.) were used. Agglutinogens A and B were found in both salivas, whereas M and N could not be demonstrated in either.

Boyd, Julian D., V. D. Cheyne, K. E. Wessels, 1948. CORRELATION OF LACTOBACILLUS COUNTS WITH CARIES EXTENT IN AN INSTITUTIONAL POPULATION. Jour. dent. Res., 27 (6): 736-737.

Lactobacillus counts were made of the paraffin-stimulated saliva of over 200 institutionalized children. No correlation was noted between the lactobacillus counts and the extent or rate of progression of dental caries.

Boyd, J. D., Virgil D. Cheyne, and Kenneth E. Wessels, 1949. IS THE SALIVARY LACTOBACILLUS COUNT A VALID INDEX OF ACTIVITY OF DENTAL CARIES? Proc. Soc. exper. Biol. Med., 71 (4): 535-537.

The inconstancies of the relationship between the salivary lactobacillus counts of 64 subjects, observed serially for 2-1/2 years, and the relative rate of caries progression, denoted the salivary lactobacillus count to be an invalid index for the diagnosis or prognosis of caries activity for the individual subject within this group.

Bradbury, Edward P., 1879. ABSENCE OF SALIVA. Boston med. surg. Jour., C (10): 342.

An account is given of a man 24 years of age whose parotid, submaxillary, and sublingual salivary glands showed no evidence of secretion.

Bradford, William L., and Justus B. Roberts, 1936. THE LYSOZYME CONTENT OF BLOOD. Jour. Pediat., 8 (1): 24-30.

A study was made of the lytic effect of the blood of 9 normal healthy individuals and another group of persons suffering from various disease conditions. The lysozyme titer of serum (as indicated by lysis of *Micrococcus lysodeikticus*) in acute infections did not differ greatly from the normal. In normal controls, and in children during an acute infection, lysozyme content of the leucocytes seemed to be increased or decreased in direct relation to the percent of polymorphonuclear cells present.

The author suggest that, in view of the great activity of the leucocytes, the lytic activity of nasal mucus, saliva, or milk may depend upon the leucocyte content of the material.

Bradley, James L., 1948. THE RELATION OF CELLULAR ELEMENTS OF THE SALIVA TO CARIES. Oral Surg., 1 (5): 423-426.

A preliminary study is presented on the relation of the cellular elements of saliva to caries. Salivary smears and a caries index were taken from 517 patients. The smear was dried and then stained with Wright's stain. Two groups of cells were observed: epithelial cells and leucocytes. The cases showing epithelial cells with many bacteria present and a few leucocytes gave a caries index average of 17.62 percent, while the cases showing numerous leucocytes and few epithelial cells with few bacteria present showed an index average of 32.6 percent. The preliminary conclusion is that there is some relation between the caries indices and the cellular condition of saliva.

Bradley, J. Edmund, and Margaret Tilghman, 1952. IN SITU HYDROGEN ION MEASUREMENTS OF THE MOUTH, ESOPHAGUS AND STOMACH IN NEWBORN INFANTS. Amer. Jour. digest. Dis., 19 (8): 255-257.

Results are reported of hydrogen ion concentrations of the mouth, esophagus, and stomach in 42 normal, full-term infants ranging in age from 3 to 48 hours of age. The measurements were obtained in the fasting subjects by glass electrode. A mean H-ion value of 6.9 was obtained in the first day of life, and of 6.3 in the second day.

Brahn, B., and F. Schiff, 1929. DAS CHEMISCHE VERHALTEN DER SEROLOGISCHEN GRUPPENSTOFFE A UND B, IHR VORKOMMEN UND IHR NACHWEIS IN KÖRPERFLÜSSIGKEITEN [Chemical behavior of serological agglutinins A and B, their occurrence and its demonstration in body fluids]. Klin. Wochenschr., 8 (33): 1523-1525.

Agglutinins A and B can be found in saliva and other body fluids. In order to determine the chemical composition of the agglutinin, about 600 cc. human saliva was collected, centrifuged, acidified and precipitated. Results indicated that these substances cannot be considered to be grouped as an albumin, lipid, or carbohydrate. Their affiliation to nitrogen compounds has to be determined.

Bramkamp, R. G., 1936. THE PROTEIN CONTENT OF HUMAN PAROTID SALIVA. Jour. biol. Chem., 114 (2): 369-371.

Saliva samples (stimulated with paraffin, lemon, ether, 1% tartaric acid, or 1% citric acid), were collected from one healthy male (30 years of age) and analyzed for total and non-protein nitrogen by a modification of Howe's Kjeldahl method.

The rate of parotid secretion (measured in cm./min.) plotted against the protein nitrogen (mg./100 cc.) showed a fairly consistent increase of protein nitrogen concentration with an increase in secretion rate. The range of protein nitrogen was from 11 mg./100 cc. of saliva at a rate of 0.5 cc. per minute to an average of 58 mg./100 cc. at rates approximating 2 cc./min.

Chemical tests showed the protein present to be largely albumin; a quantitative analysis was not made. Tests for mucoprotein were negative except in mixed saliva which contained considerable amounts of mucin and showed little change of protein content with change of secretion rate. Mixed saliva contained an average of 40 mg. of protein nitrogen per 100 cc. of saliva when produced at a rate of 2 cc./min.; when produced at a rate of 9 cc./min, the average was 30 mg./100 cc.

Bramkamp, Robert G., 1937. UREA AND CHLORIDES IN HUMAN PAROTID SALIVA. CHANGES AT DIFFERENT RATES OF SECRETION AS AFFECTED BY ATROPINE AND PILOCARPINE. *Jour. Lab. clin. Med.*, 22 (7): 677-680.

Human parotid saliva, stimulated by paraffin (for slow secretion) and by lemon (for rapid secretion) was examined for urea and chloride contents; the effects of oral administration of atropine sulfate (1/50 g.) and pilocarpine hydrochloride (1.6 g.) were observed. Blood samples were also analyzed.

A direct correlation was observed between the chloride content and the rate of secretion effected by atropine or pilocarpine. The salivary urea concentration, however, was not significantly influenced by either the drugs or the rate of secretion.

From the difference in the effects of salivary secretion rate on the content of urea and that of chlorides, the author suggests the possibility that the two substances are secreted by different paths, the chlorides directly by glandular cell activity, and the urea possibly by some process of filtration.

Brancovici, Michel, 1928. L'HYPERSÉCRÉTION MODIFIÉE-ELLE LA RADIOSENSIBILITÉ DE LA GLANDE SOUS-MAXILLAIRE? [Does hypersecretion modify the radiosensitivity of the submaxillary gland?]. *Compt. rend. Soc. Biol. (Paris)*, 99 (26): 757-758.

The submaxillary glands of five dogs were irradiated with x-rays, the chorda tympani of one side being stimulated with faradic current. Three of the dogs received radiation for 1 hour. Histological examination of the submaxillary glands 6, 9, and 11 days later showed normal cells except for rare islets scattered in the two glands where nucleus, cytoplasm, and mitochondria showed changes that were more marked in the stimulated gland. The remaining two dogs received strong dosages of radiation and died on the 3rd and 10th day after treatment.

In a second series of tests, dogs had the chorda tympani cut and the gland irradiated or not irradiated. The author concludes that the functional activity of the submaxillary gland has no effect on the radiosensitivity of the gland.

Brandgendler, V. S., and V. A. Muzykantov, 1933. K VOPROSU O VLIYANII DLITEL'NYKH PISHCHEVYKH REZHIMOV NA VYSSHUIU NERNUIU DEIATEL'NOST'SOBAK [On the influence of prolonged food diets on the higher nervous functions in dogs]. *Ark. biol. Nauk, Leningrad*, 33 (1-2): 81-95.

The influence of prolonged carbohydrate or meat diet on the higher nervous functions was studied in detail in three dogs, one of which was of the well balanced and two approaching the extreme nervous types, one predominantly irritable, the other predominantly inhibited. The salivary secretion served as indicator for the conditioned and unconditioned food reflexes. To establish the normal standard of the salivary reflex, a mixed meat and carbohydrate diet was given. The meat diet consisted of 600 to 1000 gm. of meat and 400 to 600 gm. of black bread; the carbohydrate diet, of bread (400 to 600 gm.) fresh cabbage (200 gm.), and potato soup (600 gm. potatoes), with 2.5 gm. salt added. The feeding was done at regular 3 to 4 hour intervals. The following conditioned reflexes had been worked out: in response to the sound of the metronome (120 or 160 strokes/min.), bell, electric lamp of two different intensities, skin stimulation by needle pricks on the side (30 pricks/30 sec.), and differentiation to 60 metronome strokes/min. and needle pricks on the shoulder. Unconditioned stimulation was done by rusk powder.

The fundamental changes in higher nervous functions after the passage from one diet to another were the same in all three dogs, with small individual variations not affecting the general pattern. One dog will serve as example.

During the mixed diet, the unconditioned reflex value was 261 divisions of the water register, the conditioned reflex values were: metronome, 126; strong light, 116; bell, 115; pricking, 114; weak light, 109; all the differentiation reflexes were disinhibited.

After passage from the mixed to the carbohydrate diet, an increase in all the conditioned reflexes was observed which lasted 10 days. The degree of intensity in the response to the various conditioned stimulations [i.e. the salivary secretion rate] changed: strong light, 140; metronome, 132; weak light, 127; bell, 124; pricking, 118. The unconditioned reflex was also increased (276). The differentiation inhibition remained sharply decreased. Beginning with the 10th or 11th day, the rate of conditioned salivary secretion dropped noticeably. The correlation in the intensities of conditioned stimulations changed again: strong light, 114; metronome, 102; bell, 96; pricking, 91; weak light, 77. The unconditioned reflex rose to 285, then fell to 258 and returned to 270. Absolute differentiation inhibition was observed. Thus, the carbohydrate diet, applied after the mixed, produces a twofold change in the higher nervous function of the animal: in the first phase, conditioned and unconditioned reflexes are increased, in the second, the conditioned reflex is decreased, the unconditioned increases first, then tends to decrease. After 24 days, when the unconditioned reflexes became stabilized at a somewhat lower level, and the unconditioned at a somewhat higher, the dog was transferred to the meat diet.

Beginning with the first days of the meat diet, the conditioned and unconditioned reflexes showed a tendency to decrease, and on the 9th

to 10th day an extremely low salivary secretion level was reached. In a few experiments, no conditioned secretion could be obtained, except for the bell. The correlation in the intensities of conditioned stimulations changed again: strong light, 25; bell, 20; pricking, 20; weak light, 15; metronome, 5. The unconditioned reflex was reduced in some experiments to 50% of its former value (158). The differentiation stimulations produced a zero effect and negative movement reaction with squealing and barking. After this period, all conditioned and unconditioned reflexes kept increasing until the end of the meat diet, i.e. for nearly 40 days (strong light 140, metronome 120, pricking 118, bell 112, weak light 110; unconditioned reflex 359). The differentiations first persisted, then weakened. Thus the meat diet, applied after the carbohydrate, produces considerable changes in the higher nervous functions of the dog: in the first phase the salivary response to all conditioned stimulations, as well as the unconditioned reflex drops abruptly; in the second, more prolonged period, all the conditioned and unconditioned reflexes increase. The differentiation inhibition, which is absolute in the first phase, decreases in the second. After stabilization of the reflex values, the conditioned reflexes remain at a higher level than in the preceding carbohydrate diet, close to that of the mixed diet; the unconditioned reflex remains at a higher level than in the carbohydrate and in the mixed diets.

On the 55th day the animal was again transferred to the carbohydrate diet. The changes observed this time were somewhat different from the changes after the passage from a mixed diet: the first phase (increase of the conditioned and unconditioned reflexes) dropped out; from the first days, all conditioned reflexes, except the response to weak light, and the unconditioned reflex decreased. A rather long phase appeared after 6 to 7 days in which some conditioned reflexes continued to decrease, others approached the same level or remained stable. The unconditioned reflex values were: strong light 107, weak light 105, metronome 103, pricking 100, bell 94; unconditioned reflex 259. The differentiation inhibition shows variations and failures which cannot be put in line with the basic process. Thus, the carbohydrate diet, applied after the meat diet, produces changes in the higher nervous functions of the animal which amount to a decrease in stimulation capacity. The differences observed in both carbohydrate diets indicate that the influence played by the preceding diet has to be taken into account.

Brassfield, Charles R. and Vivian G. Behrmann, 1936. COMPARISON OF THE BUFFERING POWER OF SALIVA OBTAINED UNDER CHORDA TYMPANI STIMULATION WITH THAT OBTAINED WITH PILOCARPINE. *Amer. Jour. Physiol.* (London), 116 (1): 14-15.

Determinations were made of the pH of chorda-stimulated saliva from the submaxillary gland of anaesthetized dogs, equilibrated at 37°C with CO₂ tension ranging from 0 to 100 mm Hg., and the resulting curves were compared with curves derived from pilocarpine-stimulated saliva. Initial reactions of the two types of saliva from the same dog usually showed slightly higher pH for the chorda saliva, while curve comparison showed similar buffering power. The greatest change in

pH occurred between CO₂ pressures of 0 to 30 mm Hg., with a decrease of 1 pH unit. The decrease between 30 and 100 mm Hg. was 0.4 pH.

Brassfield, Charles R., 1936a. COMPARISON OF CHANGES IN THE pH OF ARTERIAL BLOOD AND SALIVA DURING VARIATIONS OF PULMONARY VENTILATION. *Amer. Jour. Physiol.*, 116 (1): 174-181.

"pH determinations were made by means of the glass electrode on blood samples taken from the femoral artery and on saliva samples taken from the submaxillary gland of anesthetized dogs. Continuous pH measurements also were made by mounting a glass electrode in the flowing saliva elicited by a continuous injection of pilocarpine.

"A comparison of the pH values of saliva and arterial samples over periods of two hours or longer showed that while the arterial pH remained quite constant saliva pH showed large variations of which the majority were toward the alkaline side.

"Lowering the oxygen tension of the inspired air caused an increase in the pH of arterial blood with a decrease toward or below the resting level if the administration were prolonged. The resting level was quickly reached upon returning the animal to room air. The pH of saliva increased at the beginning of the administration and then decreased below the pre-administration level in a majority of experiments. The initial increase was sometimes absent. If the administration were prolonged, a second increase might occur and in most cases a marked increase took place upon returning the animal to room air. The increase during recovery was usually above the pre-administration level and the pH frequently remained at this new level.

"Injection of sodium cyanide caused an increase in both blood and saliva pH during the intense respiratory stimulation. If cessation of respiration occurred for a time both blood and saliva pH decreased but returned to pre-administration values with recovery of respiration, saliva showing a more rapid recovery than that of blood. If failure of respiration did not occur the blood pH returned to resting values but saliva pH showed a decrease accompanying the increased secretory rate and then increased to or above resting values with the return of the secretory rate to the preadministration value.

"The initial alkaline change in the saliva with low oxygen administration or with cyanide injection is attributed to a decrease in carbon dioxide produced by hyperventilation. The subsequent changes in the saliva pH are attributed more to disturbances of the cellular metabolism produced by the impairment of oxidations and the recovery of these processes than to the pH of arterial blood." (Author's summary and conclusions.)

Brassfield, Charles R., and Charles J. Hong, 1939. CHANGES IN PH AND THE RATE OF FLOW OF SALIVA ACCOMPANYING pH CHANGES IN ARTERIAL BLOOD DURING CHORDA TYMPANI STIMULATION AND DURING PILOCARPINE STIMULATION. *Amer. Jour. Physiol.*, 126 (3): 442.

Lowering the O₂ tension of the blood of the dog produced an increase in the pH of the blood and of the saliva (elicited by continuous stimulation of the chorda tympani with a thyatron stimulator); the increase in salivary pH was smaller than that noted in the blood. Increasing

the CO₂ tension of the blood produced approximately equal pH changes in blood and saliva. No change in rate of salivary flow was noted in either case.

Injections of lactic acid and hydrochloric acid caused no change in salivary pH or rate of flow.

Similar results are not obtained when pilocarpine is used to stimulate the saliva flow, indicating a possible difference in the mode of action of the two stimuli. Injection of sodium carbonate or bicarbonate, with chorda tympani stimulation however, did produce an increase in salivary pH and a decrease in flow as occurs with pilocarpine stimulation. Sodium cyanide injection also caused a rise in salivary pH, and an increase in flow followed by a decrease, as frequently occurs with pilocarpine stimulation.

Brassfield, Charles R., and A. P. Hands, 1941. CHANGES IN pH AND THE RATE OF FLOW OF SALIVA ACCOMPANYING pH CHANGES IN ARTERIAL BLOOD DURING ACETYLCHOLINE STIMULATION OF THE SUBMAXILLARY GLAND. *Amer. Jour. Physiol.*, 133 (2): P222.

The effects of induced changes of the pH of the arterial blood on the pH and rate of flow of the submaxillary saliva were studied in dogs during acetylcholine stimulation. The pH of the blood was varied by changing the oxygen and carbon dioxide tensions of the inspired air and by injecting certain acids and bases.

Lowered O₂ tension of the inspired air produced parallel increases in the pH of saliva and blood; the saliva change was less. The salivary flow was increased at the beginning of the administration, but decreased later. Increased CO₂ tension of the inspired gas induced a decrease in pH of both blood and saliva, changes in the saliva being less. The saliva flow was also decreased. Overventilation produced an increase in salivary flow and an increase in salivary pH. Lactic acid injection decreased the flow of saliva and its pH; sodium bicarbonate increased the flow, but decreased the pH.

The author concludes that those experimental procedures which caused a greater pH increase in blood than in saliva increased the salivary flow, while those procedures which caused a greater pH decrease in blood than in saliva decreased the flow.

Brassfield, Charles R., 1945. FLOW AND pH CHANGES IN SUBMAXILLARY SALIVA ASSOCIATED WITH VARIATIONS IN ACID-BASE EQUILIBRIUM. *Amer. Jour. Physiol.* 144 (1): 43-50.

"Overventilation in dogs receiving a continuous injection of pilocarpine produces an increase in the pH of both blood and saliva. These changes are attributed primarily to decreased CO₂ tensions. The change in salivary pH is smaller [0.03] than the pH change in the arterial blood [0.37]. This is thought to be due to the decrease in content of base resulting from a slower rate of secretion.

"Administration of low O₂ [9.2%] in a mixture containing CO₂ approximating the tension of this gas in the arterial blood [4.83%] produces a greater decrease of pH in saliva than in arterial blood. Disturbances of the cellular metabolism induced by the impairment of oxidations contribute to this decrease in salivary pH. Since the increased salivary flow [by 33%] accompanies the decreased salivary pH but precedes the blood pH decrease, the increased secretion is attributed

to the increased intracellular acidity. [A further 50% increase in salivary flow occurs upon returning the animal to room air].

"The effect of administering air containing more than 8 percent CO₂ is to produce initially a greater pH decrease in blood [] than saliva [0.24]. After the initial decrease in saliva pH an increase is obtained [0.14] and a further increase occurs on returning the animal to room air. With low percentages of CO₂ only increases in salivary pH are produced. [At the beginning of the procedure, the highest rate of flow (a 180% increase) occurs].

"Large injections of lactic acid produce parallel decreases in both blood and saliva but the change in saliva is less. Small or slow injections may produce an increase in salivary pH. [The secretion rate of saliva increases 300% immediately following the injection, gradually returning to pre-injection rate]. Sodium bicarbonate injections usually produce an increase in saliva pH which is much less than the pH increase in blood. Sometimes the pH of saliva shows an initial decrease."

"Ammonium chloride injections produce much greater decreases in saliva pH than in blood [a 1.5% injection of ammonium chloride effects a 0.59 pH decrease]."

"Saliva flow changes are related to variations of intracellular acidity rather than to the reaction of either blood or saliva. A probable mechanism for the enhancement of flow by an increase in intraglandular acidity is suggested." (Author's summary).

Brawley, Robert E., 1934. EFFECT OF VITAMINS A AND D UPON pH OF NORMAL RESTING SALIVAS OF SCHOOL CHILDREN. *Jour. dent. Res.*, 14 (3): 211-212.

Advance abstract of Brawley, 1935o.

Brawley, Robert E., 1935. STUDIES OF THE pH OF NORMAL RESTING SALIVA. I. VARIATIONS WITH AGE AND SEX. *Jour. dent. Res.*, 15 (1): 55-77. Abstract: *Jour. dent. Res.*, 15 (3-4): 211.

Colorimetric pH-determinations were made in resting saliva of 3405 normal healthy individuals, both male and female, ranging in age from 3 weeks to 101 years. The mean or average pH of normal resting saliva, for the entire group, was 6.75, which showed that normal resting saliva is slightly acid-median pH, 6.84. The average pH of normal resting saliva of various age-groups did not vary significantly from the general average, except in the age extremes. In the age-groups 3 weeks to 1 year, the average was slightly higher—in age-groups 80-90 years and 90-100 years, slightly lower—than the general average. The average for males was 6.76; females, 6.73. Slight differences existed between males and females in certain age-groups (50-60, 70-80, and 80-90 years), in which the average for females was slightly more acid. The range was from pH 5.6 to 7.6; 55 percent fell within 6.6 to 7.0; 83 percent, within 6.2 to 7.4; only 5 percent, within the combined ranges of 5.6 to 6.0 and 7.4 to 7.8. The distribution was very similar in all age-groups, the "spread" having been a little greater in the adult groups. The males comprised 54 percent of the entire group; females, 46 percent. Approximately the same percentages of total cases existed in each pH group except that

of 5.6-6.2, where of the number of cases males were 40 percent; females, 60 percent. In the range 7.2-7.4, the division was 62 percent males, 38 percent females; in the range 7.4-7.8, 64 percent males, 36 percent females. (Author's abstract)

Brawley, Robert E., 1935a. STUDIES OF THE pH OF NORMAL RESTING SALIVA. II. DIURNAL VARIATIONS. Jour. dent. Res., 15 (2): 79-86. Abstract: Jour. dent. Res., 15 (3-4): 211-212.

Colorimetric pH determinations were made in normal resting saliva of 3405 normal healthy individuals, male and female, ranging in age from 3 weeks to 101 years. Determinations were made at various hours from 7 a.m. to 5 p.m. Average pH of normal resting saliva varied throughout the day; during the hour before meals, it was slightly higher than normal (pH 6.75). It was 6.80 before breakfast; 6.83 before lunch; slightly lower than normal during the hour following meals--6.73 after breakfast; 6.68 after lunch. There was similar diurnal variation for different age-groups; variation throughout the day was similar in males and females. There was no significant difference between morning and afternoon averages.--6.76 and 6.74, respectively. (Author's abstract)

Brawley, Robert E., 1935b. STUDIES OF THE pH OF NORMAL RESTING SALIVA. III. EFFECTS OF VITAMINS A AND D IN SCHOOL CHILDREN. Jour. dent. Res., 15 (2): 87-88.

One hundred and thirty-three school children, between the ages of 11 and 17 years, were given 6 vitamin-concentrate tablets daily (each tablet containing a minimum of 1500 units of vitamin A and 2450 units of vitamin D) for one year; the effect upon the pH of normal resting saliva was determined colorimetrically at the end of 6 and 12 months. Another group of 164 school children served as control.

It was seen that administration of vitamins A and D did not significantly affect the salivary pH. There was no marked difference between the pH of normal resting saliva of the two groups. For the experimental group, the pH was 6.76, at the end of 6 months and 6.79, at the end of the year; for the control group it was 6.75 and 6.78, respectively.

Brawley, Robert E., 1936. [THE] pH OF NORMAL RESTING SALIVA. IV: RELATIONSHIP TO DENTAL CARIES. Jour. dent. Res., 15 (5): 361.

Colorimetric pH determinations (Clark and Lub) on resting saliva of 281 school children; male and female, average age 13.2 years. Data correlated with quantitative caries-indices (method of Mellanby, modified by Day and Sedwick). pH indices established at beginning and end of 12-month period. No relationship existed at either examination, but when increase in caries index compared with pH of salivas, definite relationship expressed itself as (a) low pH ranges, high caries indices; (b) high pH ranges, low caries indices. [Author's abstract]

Brawley, Robert E., and H. Jobe Sedwick, 1936a. BACTERICIDAL ACTION OF SALIVA. II: FACTORS THAT INFLUENCE INHIBITORY AGENT. Jour. dent. Res., 15 (5): 361-362.

Various media and species of organisms, and resting and activated samples of saliva from male and female subjects, used. Following factors influenced inhibitory agent, positively or negatively: (a) Saliva--incubation, refrigeration, filtration, centrifugation, dilution, heat, cold, acids, alkalies, pH, rays and amount per "well." (b) Saliva and medium--incubation and refrigeration. (c) Subject--salivary Ca, P, Mg, mucin, copuscles, rate of flow, pH, viscosity, diurnal and day-to-day variations. (d) Medium--kind, amount per plate, depth of "well," diameter of "well," pH, and refrigeration. (e) Organism--strain used, and amount of inoculum. [Author's abstract].

Brawley, Robert E., and H. J. Sedwick, 1938. STUDIES CONCERNING THE ORAL CAVITY AND SALIVA. IV. CALCIUM (1) CALCIUM CONTENT OF RESTING AND ACTIVATED SALIVA OF CHILDREN. Jour. dent. Res., 17 (6): 477-492.

The Clark-Collip modification of the Kramer-Tisdall method for serum calcium determination was used when saliva samples from 794 normal, healthy children (547 males and 247 females), divided into four age groups between 1-20 were analyzed. A "resting" and a paraffin-stimulated sample were collected in the morning at least one hour after breakfast. The samples were shaken thoroughly and were allowed to stand for at least one hour before calcium determination; then, the deproteinized saliva was precipitated as oxalate, washed, titrated with KMnO_4 , and calculations were made. The test solution contained 10 mg. of calcium per 100 cc. of solution.

Results indicated that differences which existed between the calcium values for males and females in either resting or activated saliva were not significant; similarly there were no significant differences between the mean calcium values of the various age groups (1-6, 6-10, 10-15, and 15-20) studied for either type of saliva. When sex and age were disregarded and the standard deviation, standard error of the mean, and ranges of individual determination were calculated, the calcium values were 6.88, ± 0.88 , ± 0.87 , ± 0.03 , and 3.2 to 10.0 mg calcium per 100 cc. saliva. The difference between the means of resting and activated saliva of .66 mg. of calcium per 100 cc. was quite marked. Mean distribution values of calcium for both saliva groups were relatively similar: 91% of calcium of the resting saliva fell within the range of 5.5 to 8.5 mg. calcium per 100 cc; for the activated saliva 91% of the total fell within the range of 4.5 to 7.5 mg calcium per 100 cc. When $\pm$ twice the standard deviation of the around the mean was calculated, 95% of the total number of cases were included. It is concluded that the standard range for salivary calcium for children 6-18 years of age would be 5.1 to 8.6 for resting saliva per 100 cc, and 4.5 to 8.0 mg. of calcium for activated saliva per 100 cc.

Brawley, Robert E., and H. J. Sedwick. STUDIES CONCERNING ORAL CAVITY AND SALIVA. IV. CALCIUM. (1) CONTENT OF CHILDREN'S SALIVA. Jour. dent. Res., 17 (4): 293.

"Calcium determinations made on resting and activated saliva of 780 children, 3-18 years of age. The data show: (1) No significant

differences with age or sex, (2) significant variations with season and type. Average calcium values in mgs. per 100 cc., resting saliva 6.89, activated 6.24." (Complete paper.)

Brawley, Robert E., J. H. Sedwick, 1940. STUDIES CONCERNING THE ORAL CAVITY AND SALIVA. V. PHOSPHORUS (INORGANIC PHOSPHORUS CONTENT OF RESTING AND ACTIVATED SALIVA OF CHILDREN). Jour. dent. Res., 19 (3): 315.

A study was made of the inorganic phosphorus content of the resting and activated saliva of 522 male and 236 female school children, aged 6 to 17 years. The mean phosphorus content of resting saliva was found to be 12.53 mg./100 cc., while that of activated saliva was 11.15 mg./100 cc.; no significant differences were noted in the mean values in regard to age or sex.

Brawley, Robert E., and Jobe H. Sedwick, 1940a. STUDIES CONCERNING THE ORAL CAVITY AND SALIVA. VI. HYDROGEN-ION CONCENTRATION (pH OF RESTING AND ACTIVATED SALIVA OF CHILDREN). Jour. dent. Res., 19 (3): 316.

A study was made of the pH of the resting and activated saliva of 547 male and 244 female school children, aged 6 to 17 years. The mean pH value of resting saliva was 6.77 while that of the activated saliva was 7.45; there was no significant difference in the mean values with age or sex. [From author's abstract]

Brawley, Robert E., and Jobe H. Sedwick, 1940b. STUDIES CONCERNING THE ORAL CAVITY AND SALIVA. VII. RATE OF FLOW (RATE OF FLOW OF RESTING AND ACTIVATED SALIVA OF CHILDREN). Jour. dent. Res., 19 (3): 316.

A study was made of the rates of flow of resting and activated saliva of 519 male and 248 female school children, aged 6 to 17 years. The mean value for the resting saliva of males was 0.51 cc./min.; for females, 0.35 cc./min.; both males and females, 0.46 cc./min.. The mean value for the activated saliva of males was 1.41 cc./min.; for females, 1.07 cc./min.; both males and females, 1.30 cc./min.. Mean values were also found to increase with age. [From author's abstract]

Bray, H. G., H. Henry, and M. Stacey, 1946. CHEMISTRY OF TISSUES. 2. POLYSACCHARIDES SHOWING BLOOD GROUP A-SPECIFICITY AND THE NATURE OF THE CONSTITUENT UNITS OF THE STABLE CARBOHYDRATE RESIDUE OF THE A SUBSTANCE FROM PEPSIN. Biochem Jour., 40 (1): 124-130.

A method (modification of the Sevag method) is described for the preparation of a soluble polysaccharide-amino-acid complex from human saliva and other sources; the degree of polysaccharide activity was measured by their ability to neutralize the corresponding agglutinins contained in human serum, and the number of agglutinin units per ml. of anti-A serum were determined.

The minimum amount of group A human saliva detectable by the anti-A isoagglutination test was 4 μ g., but group B human saliva showed no reaction; however when group B saliva was tested against anti-B serum its minimal detectable amount was also 4 μ g.

The results of experiments on non-saliva compounds are described.

Brekhus, Peter J., and W. D. Armstrong, 1934. SOLUTION TENDENCY OF APATITE IN SALIVA. Jour. dent. Res., 14 (3): 165.

Advance abstract of Brekhus, 1934.

Brekhus, Peter J., and W. D. Armstrong, 1934a. SOLUTION RATE OF APATITE IN AN AVERAGE MOUTH. Jour. dent. Res., 14 (6): 455-456.

In studying the probability that the inorganic phase of bones and teeth is apatite, the authors conducted the following experiment: A removable bridge, having 3 mm. deep and square holes on the lingual and buccal sides in which cubical pieces of apatite were sealed, was carried by one of the authors (W. D. A.) for one year. The loss of weight of the lingual piece (originally 48.005 mg.) was 0.034 mg. or 0.07%; for the buccal piece (originally 39.597 mg.), the loss of weight was 0.052 mg. or 0.13%.

The authors conclude that "the rate of solution of apatite in an average mouth is low enough to be compatible with the evidence that the inorganic phase of enamel is apatite".

Brewer, H. E., and J. C. Muhler, 1958. ALTERATION OF BLOOD FLOW TO THE TEETH. II. ITS EFFECT ON DENTAL CARIES AND RELATION TO SALIVARY GLAND STRUCTURE AND FUNCTION IN THE RAT. Jour. dent. Res., 37 (6): 1069-1076.

As part of a larger study an investigation was made in 10 adult male and female rats regarding the effect on salivary flow produced by ligation of both the internal and external maxillary arteries. Bilateral salivary flow was determined from the cannulated ducts of the submandibular glands, stimulated by injection of pilocarpine nitrate into the external jugular vein. Nine similar unoperated animals served as controls. No statistically significant difference was found between rates of salivary flow of right or left glands of the same unoperated animal or between unoperated glands of different animals. A tendency for a higher salivary flow was noted in operated animals.

Briggs, E. F., 1934. OUR EMOTIONS. ARE THEY THE CONTROLLING FACTOR IN DENTAL CARIES? Oral Hyg., 24: 1130-1134.

A discussion is presented on the relationship between dental caries and different emotional states, as worry, grief, anxiety, or any depressed state of mind. It is suggested that these factors control the buffer substance of saliva or cause some change in metabolism that is responsible for dental caries.

Broderick, F. W., 1921. THE EFFECT OF ENDOCRINE DERANGEMENT ON THE TEETH. Dent. Cosmos, 63 (2): 135-147.

An investigation of the literature indicates that endocrine imbalance results in Ca starvation of body tissue and in lowered alkalinity of saliva. A study of 700 cases of acute disease showed measles, tuberculosis, whooping cough, and scarlet fever to produce complete or chronic degeneration of the thyroid. Examination of saliva of children with measles or scarlet fever showed a lower alkalinity and Ca content than that of the author which was used as a control. Contraction of scarlet fever by the author subsequently produced a similar drop in alkalinity and Ca index. Administration of a pluriglandular

(thyroid, suprarenal, pituitary) extract resulted in an increase in both children's and author's salivary alkalinity and Ca index. Continued experimentation with pluriglandular extract has shown that intramuscular injection acts quicker to raise the Ca index and pH of the saliva than oral administration of the extract. The effects of Ca metabolism on caries are discussed.

Broderick, F. W., 1932. THE SALIVA IN RELATION TO CARIES. *Brit. dent. Jour.*, 53 (9): 523-527.

A study was made of the effect of various factors on the salivary pH. Breathing excessive CO₂ lowered the pH of saliva and at the same time increased the amount of base it contained. Vigorous forced breathing caused an increase in pH accompanied by a diminution of alkali. A disturbed acid-base ratio of the blood, brought about by the ingestion of an alkali salt, resulted in an increased pH and alkalinity.

Brody, Henry, and Moses Samuel Shiling, 1930. A NOTE ON THE RELATION OF SALIVARY SECRETION TO THE OXYGEN TENSION OF THE INSPIRED AIR. *Amer. Jour. Physiol. (London)*, 91 (2): 399-404.

The effects of breathing gas mixtures low in oxygen on the salivary secretion of the submaxillary glands were studied in 8 dogs anesthetized with amytal. The Wharton ducts of both glands were exposed and cannulated; the lingual nerves were severed. The secretory rate was recorded for both glands simultaneously.

In one group of experiments on the response to the electrical stimulation of the chorda tympani, inspired gas mixtures with diminished oxygen (10%) had no noticeable effect on the rate of salivary secretion.

In another group pilocarpine (intravenous injection of 1.5 cc. of 1% solution) stimulation caused a marked difference in the response of the gland when the dog was breathing room air, and when breathing the diminished oxygen (10%) gas mixture. There was a distinct decrease in the secretion in the low-oxygen tests.

In the last group, when the gland was secreting at a steady rate following an injection of pilocarpine (0.5 cc.), diminished oxygen gas mixture produced decreases in the secretory rate of 50% or more, with immediate recovery upon readministration of room air.

Broeze, J. R., 1931. DIE EINWIRKUNG DES PTYALINS AUF STÄRKE. II. ELEKTROLYTEINFLUSSE [The effect of ptyalin on starches. II. The influence of electrolytes]. *Biochem. Zeitschr.*, 231 (4-6): 365-384.

The capillary-chemical conditions of the particles of the colloid medium had a considerable effect on the speed of the enzyme reaction. The increase of this speed through small concentrations of different electrolytes was connected with the discharge of negative colloid particles. A 2% starch solution was prepared; the salivary solution was dialyzed against 10 liters distilled water. The interpretation of the anion lyotrophy noted already in small concentrations was difficult. The lyotrophy was apparent already at ptyalin concentrations of 0.5 milliequivalent. The cation lyotrophy (Li, Na, K), however, was insignificant throughout the experiment. It is assumed by the author that the discussed

electrolytic influences are not only due to the capillary chemical changes of the starch colloid particles but also to an increase in the activity of the enzymic system proper.

Bronk, Detlev W., and Robert Gesell, 1926. ELECTRICAL CONDUCTIVITY, ELECTRICAL POTENTIAL AND HYDROGEN-ION CONCENTRATION MEASUREMENTS ON THE SUBMAXILLARY GLAND OF THE DOG RECORDED WITH CONTINUOUS PHOTOGRAPHIC METHODS. *Amer. Jour. Physiol.*, 77 (3): 570-589.

The electrical resistance (conductivity), electrical potential, and hydrogen-ion concentration of 28 morphine-urethane anesthetized dogs were photographically recorded. A vacuum tube resistance recorder, for measuring the submaxillary gland electrical conductivity, was devised especially for such determinations, and is explained in full detail. Graphed results show that an increased resistance accompanies the production of a visible or observable salivary secretion. Occlusion of Wharton's duct, occlusion of the carotid artery, injection of pilocarpine, and vago-sympathetic stimulation, all produce an increased but varying electrical resistance response by the gland. Asphyxia tends to stimulate a slight decrease in resistance. Secretory responses of the submaxillary, especially with a diminished blood supply or occlusion of the ducts, is accompanied by an increased acidity of the venous blood from the gland.

It is suggested that deviations in electrical conductivity of the gland may be accountable to changes in the resistance on the luminal side of the cell and/or the opposite side (basement membrane portion).

Brooke, James W., 1938. REGIONAL STUDY OF BACTERIA IN CLINICALLY NORMAL MOUTHS. *Jour. dent. Res.*, 17 (1): 57-67.

The bacterial flora of four sites (lower lingual anterior region, lower posterior molar region, and the regions of Stenson's duct and Wharton's duct) of 50 clinically normal mouths were examined. A morphological tabulation of the bacteria present was made.

Forty-five mouths harbored spirochetes together with fusiform bacilli. Smears, from 10 of these 45 mouths, were indistinguishable from smears obtained from cases of acute Vincent's infections. The accuracy of a diagnosis of Vincent's infection, based on the appearance of a smear, is questionable.

Gram-positive bacilli predominated among the bacteria, being most prevalent in the lower lingual anterior region. Gram-positive staphylococci were present in great frequency and numbers in the region of the posterior molar. Spirochetal forms and fusiform bacilli occurred frequently about the teeth but were very scarce about the orifices of Stenson's duct and Wharton's duct. The suggestion is made that the teeth afford some growth-promoting factor or that saliva exerts an inhibitory effect. Tunnicliff's theory of the identity of spirochetes and fusiform bacilli offers a possible explanation for the coincident occurrence of these organisms, the presence of one without the other being rare. The incidence of fusiform bacilli and of actinomycetoid forms was high, being greatest in the region of the lower lingual anterior region and lower posterior molar region, and lesser about the ducts.

Broomall, Annabelle, and E. A. Wolf, 1939. PHOSPHATASE IN HUMAN SALIVA. Jour. dent. Res., 18 (3): 254-255.

A study was made of the alkaline phosphomonoesterase content of the mixed saliva of 20 subjects, aged 20 to 40 years. The mean values obtained ranged from 0.1 to 2.3 units of phosphatase activity at an optimum pH of 9.0. The phosphatase content was found to vary from day to day as much as 75.3 percent in one subject and as little as 3.6 percent in another. A clear watery saliva and a highly mucoid saliva were obtained from the same subject through the use of different stimulants; tests of such salivary samples from 5 individuals showed the mucoid saliva to have from 0.6 to 4.8 units higher activity than the watery saliva.

Brothers, Joyce D., and C. J. Warden, 1950. AN ANALYSIS OF THE ENZYME ACTIVITY OF THE CONDITIONED SALIVARY RESPONSE IN HUMAN SUBJECTS. Science, 112 (2921): 751.

A study was made of the amylase activity of the conditioned salivary response in 11 female subjects. Specimens of saliva were collected before the experiment, during response to a bell before conditioning, during presentation of food, and after the process of conditioning was complete. The unconditioned stimulus was a candy wafer; the conditioned stimulus was an electric bell. A significant quantitative difference was noted in the amylase activity of the saliva secreted in response to a conditioned stimulus and that secreted as a reflex response. A mean gain of 31.7 units of amylase activity was found in the salivary conditioned response over that of the unconditioned response.

Brown, J. B., and N. J. Klotz, 1934. STUDIES ON THE CHEMISTRY OF MIXED HUMAN SALIVA. I. ATTEMPTS TO CORRELATE CHEMICAL COMPOSITION OF MIXED HUMAN SALIVA WITH RATE OF SECRETION. Jour. dent. Res., 14 (6): 435-438.

A comparison was made of the chemical composition and concentration of the saliva of 18 young men with different rates of saliva secretion. Three groups of 6 subjects each were tested: a "low producing" group which secreted an average of 55.9 cc./hour, a "medium producing" group averaging 141.9 cc./hour, and a "high producing" group averaging 251.7 cc./hour. The "low producing" salivas were found to be low in chloride content and high in phosphate content while the reverse was noted in the "high producing" salivas. Total nitrogen was decidedly higher in the "low producing" group than in the other 2 groups. Differences in pH, total solids, and ash were insignificant.

Brown, J. B., and N. J. Klotz, 1937. STUDIES ON THE CHEMISTRY OF MIXED HUMAN SALIVA. II. SODIUM, POTASSIUM AND CALCIUM IN SALIVAS SECRETED AT WIDELY VARYING RATES. Jour. dent. Res., 16 (1): 19-22. Abstract: Jour. dent. Res., 15 (5): 320.

Chemical analyses were made of the paraffin-stimulated salivas of three groups of six persons each: a "high-producing" group which averaged 243.1 cc. of saliva in one hour, a "medium-producing" group which averaged 143.3 cc. in one hour, and a "low-producing" group which averaged 61.1 cc. in one hour. The total solid, ash,

calcium, potassium, and sodium contents were determined. Sodium determinations were made on saliva filtrates by the direct method of Cally and Foulk; potassium was determined by the perchlorate-butyl alcohol method of G. F. Smith; calcium, by the Clark-Collip modification of the Kramer-Tisdall method, using the original saliva sample without deproteinization.

Results showed that sodium increased rapidly (from 2.7 to 77.2 mgm. per 100 cc. saliva) and calcium increased slightly (from 4.21 to 5.21 mgm. per 100 cc.) with rate of secretion. Potassium declined slightly with an increase in the rate of secretion (87.1 to 81.6 mgm. per 100 cc.).

A comparison was made of the values of the three constituents of the saliva with several blood serum constituents. It was indicated that the high-producing salivas apparently tend to maintain their osmotic properties at the expense of the sodium chloride from the blood, which contains more sodium and chlorine than does saliva.

Brown, J. B., H. D. Wright, and H. P. Limbacher, 1938. THE COMPOSITION OF SALIVA PRODUCED AT VARYING RATES OF SECRETION BY THE SAME PERSON WITH SPECIAL REFERENCE TO CALCIUM AND PHOSPHORUS. Jour. dent. Res., 17 (3): 191-196.

Paraffin-stimulated saliva samples were collected from one subject during 5 one-hour periods; specimens were taken and analyzed at 15 minute intervals. The average saliva production was 115 cc. per hour. Over a one hour period there was a tendency for the calcium value to decline while those for phosphorus varied, a rise in one instance was followed by a decrease. The P/Ca ratio fluctuated but showed a tendency to increase due to the calcium decline.

Different chewing stimuli were used by a subject producing 34 one hour specimens. This variation of stimuli induced a wide range of production rate (from 28 to 213 cc. per hour); the specimens produced fell naturally into three groups: low, medium and high. Chemical composition of the samples varied with the changing rate of salivary production. In general, the increase in amount of paraffin chewed stimulated a larger rate of production.

In a third experiment, the rate of secretion and the composition of the saliva of a subject chewing paraffin continuously over six hours were analyzed. The progressive fatigue of the salivary glands resulted in certain changes in the composition of the saliva. Due to the reduced secretion, solids, ash, and chloride decreased at a regular rate. Organic matter changed irregularly with a marked decline toward the end. Phosphorus rose then fell back almost to the original level. Calcium almost doubled in three samples, its concentrations approached that of the blood serum.

Brown, T. R., 1915. THE EFFECT OF CERTAIN GASTRIC CONDITIONS ON THE SALIVARY SECRETION. Jour. Amer. med. Assoc., 64 (22): 1871-1872.

Studies show that chewing of bland substances produces a considerable flow of a saliva rich in diastatic ferment. A comparison of normal cases with cases of hyper-, of hypochlorhydria, or of achylia showed no great variation from the normal quantity, alkalinity, or diastatic content of the saliva, indicative of a definite relationship between the character of the gastric juice and that of the saliva. Quantitative or ferment

changes in the saliva apparently play no great part in the development of glossitis, gingivitis, or stomatitis frequently occurring with achylia gastrica.

Brown, T. R., 1917. THE RELATIONSHIP BETWEEN DISEASES OF THE MOUTH AND GENERAL DISEASES. Jour. nation. [Amer.] dent. Assoc., 4 (8): 866-877.

A discussion is given concerning the relationship between oral and systemic diseases, including studies on saliva, bacteriology, and treatment.

Brudevold, Finn, and Roland R. Hawes, 1952. EFFECT OF PENICILLIN DENTIFRICES ON ACID PRODUCTION IN DENTAL PLAQUES AND SALIVA. Jour. dent. Res., 31 (4): 474.

"Intraoral measurements of the fall in pH in dental plaques following sucrose rinses were taken over a 7 week period in groups of dental hygiene students who used: (a) a powder containing 500 units penicillin per Gm. (11 students) (b) a paste containing 1000 units per Gm. (13 students) (c) a control paste without penicillin (21 students). No reduction was found in the acid producing capacity of the plaques in the penicillin dentifrice groups, but after a 5-week period of brushing the groups differed in acid production in morning saliva collected before toothbrushing and eating. The pH readings after 3 hours incubation with sucrose were 5.5 ± 0.4 for the penicillin powder group, 5.2 ± 0.5 for the penicillin paste group and 4.9 ± 0.2 for the control group. To study the immediate effect of penicillin, mouth rinses (250 units per c.c.) were given followed by sucrose rinses 1/2, 1, and 2 hours later. The fall in pH in dental plaques was not appreciably changed by the penicillin rinses, but acid production was markedly reduced in salivary specimens. Bacteriologic examinations of saliva showed that the penicillin dentifrices produced a slight reduction in gram-positive organisms, and an increase in resistant forms such as the coli-aerogenes group. The reduction in gram-positive organisms was somewhat more marked in the penicillin powder than in the penicillin paste group. The number of yeasts (*Monilia albicans*) and micrococci did not seem to be affected by the penicillin dentifrices." (Complete paper.)

Brudevold, Finn, and F. C. Thompson, 1954. EVALUATION OF THE MICRO-ANTIMONY ELECTRODE. Jour. dent. Res., 33 (6): 854-858.

A comparison of intraoral pH readings obtained by means of a micro-antimony electrode and a glass electrode show the readings to usually agree within 0.4 to 0.05 pH units, the antimony electrode giving the higher readings in most cases. Further, in vitro, comparisons made against salivary sugar mixtures before and after incubation for 17 or 72 hours at 37°C, showed the antimony electrode to give readings from 0.2 to 0.4 pH units higher than the glass electrode. The effects of various interfering, oral agents (lactic pyruvic, tartaric, succinic acetic, and thioglycolic acids; peroxide; calcium and phosphate ions), causing error in antimony readings, were studied at different concentrations. Intraoral micro-antimony readings are considered, except under certain conditions, only approximately correct.

Brudevold, F., M. F. Little, and J. Rowley, 1955. ACID-REDUCING EFFECT OF "ANTIENZYMES" IN THE MOUTH. Jour. Amer. dent. Assoc., 50 (1): 18-22.

Stimulated saliva samples were collected from eleven subjects before and 1, 2 and 3 hours after an oral rinse with 0.4% solution of sodium lauroyl sarcoside or of sodium lauroyl sulfate; similar samples were obtained from eight subjects using an oral rinse containing 800 units of penicillin. Determinations of the pH of the samples, incubated with glucose, showed all three rinses to reduce salivary acid production during 3-hour post-rinse period. Effects of tooth pastes and mouth rinses, containing the sarcoside or sulfate, on acid production by dental plaque material are reported and discussed.

Bruger, Maurice, J. W. Hinton, and W. G. Lough, 1941. THE IODINE CONTENT OF BLOOD, URINE, AND SALIVA OF NORMAL PERSONS IN THE NEW YORK CITY AREA. Jour. Lab. clin. Med., 26 (12): 1942-1944.

A study was made of the iodine concentration of the saliva of 22 normal persons, aged 13 to 51 years. The range varied from 3.5 to 24.0 micrograms per 100 ml. of saliva, with a mean of 10.2 ± 5.1 . In 9 males the mean concentration of iodine in whole blood was 5.7 mg/100 ml.; in 13 females, 6 mg/100 ml..

Bruger, Maurice, and Samuel Member, 1943. ON THE EXCRETION OF IODINE IN SALIVA. Amer. Jour. Physiol., 139 (2): 212-216.

Studies on the excretion of iodine in the saliva were carried out on 16 normal subjects (hospital personnel). Experiments were usually performed in the morning after breakfast. From 1 to 5 ml. of paraffin-stimulated saliva were collected. In the oral experiments, the iodine compound was administered in a gelatin capsule; in the parenteral experiments, intravenously.

Seven subjects received oral administrations of 50 to 500 mg. of potassium iodide (38 to 380 mg. of iodine). The maximum concentration of iodine in the saliva occurred in 1 to 2 1/2 hours following administration. After 50 mg. of potassium iodide had been given the concentration of iodine in the saliva reached 700 times that of the control level; and after administration of 100 to 500 mg., the concentration was 1100 to 1200 times the initial salivary iodine.

Eight subjects received intravenous injection of 25 to 100 mg. of sodium iodide (22.4 to 89.6 mg. of iodine). The greatest concentration of iodine in the saliva appeared 5 min. after the injection, then gradually tapered off.

In 6 studies on 4 subjects, iodine dissolved in poppy seed oil (Lipiodol) containing 200 mg. of iodine was administered orally and determinations of the salivary iodine were made over a period of 168 hours. Increased values for salivary iodine were similar to those obtained with equivalent amounts of iodine as potassium iodide.

In 1 individual, 123 mg. of iodine as ethyl diiodobromate (Lipiodine) was administered at 3 separate times. The highest value for salivary iodine obtained was 5.675 mg. per 100 ml. of saliva. In 2 of the 3 experiments, the maximum concentration did not occur until 5 or 6 hours after administration of the compound.

Two subjects received a capsule containing 100 mg. of sodium tetraiodophenolphthalein

(55.2 mg. of iodine). Appreciable amounts of iodine failed to appear in the saliva for as long as 72 hours after ingestion of the dye.

Bunch, J. L., 1900. ON SOME CHANGES IN VOLUME OF THE SUBMAXILLARY GLAND ACCOMPANYING SECRETION. *Brit. med. Jour.*, 2: 842-844.

A study was made of the effects of salivary secretion and blood flow-variation on the volume of the submaxillary gland. Cardiac inhibition, stimulation of the chorda tympani, or sympathetic stimulation caused the gland to shrink, while continuous stimulation of the chorda after atropinization or blockage of the submaxillary duct produced dilatation.

Bunge, M. B., and R. F. Schilling, 1957. INTRINSIC FACTOR STUDIES VI. COMPETITION FOR VIT. B₁₂ BINDING SITES OFFERED BY ANALOGUES OF THE VITAMIN. *Proc. Soc. exper. Biol. Med.*, 96 (3): 587-592.

The general nature of vitamin B₁₂ binding by gastric juice, saliva, and other biologic substances was investigated by comparative determinations of radioactive B₁₂ bound to a biologic substance after exhaustive dialysis. Saliva used in the tests was obtained before meals from one subject and filtered through coarse sintered glass. Results showed saliva to bind as much vitamin B₁₂ per mg. of protein as did gastric juice. Tests of competition for B₁₂ binding sites by 10 crystalline analogues of the vitamin showed most of the analogues to present competition similar to that offered by B₁₂ for the B₁₂ binding site of saliva. A qualitative difference in the B₁₂ binding substances of saliva, colostrum, and serum from that of gastric juice is inferred.

Bunten, J. C., 1924. SALIVATION DUE TO INTRA-VEINOUS USE OF MERCUROCHROME. *Jour. Amer. med. Assoc.*, 82 (18): 1443.

Two case histories are given in which the intravenous administration of mercurochrome-220 for septic conditions produced severe salivation, loose teeth, bleeding gums, and pain.

Bunting, Russell W., 1910. POTASSIUM SULFO-CYANATE IN THE SALIVA. *Dent. Cosmos*, 52 (12): 1346-1351.

A comparison was made between aqueous and ether extractions of 12 samples of saliva tested for potassium thiocyanate by addition of FeCl₃. The presence of diacetic acid, which also reacted with the FeCl₃, in the saliva is considered to be a possible explanation of the wide discrepancy in the results of the tests. The author concludes that FeCl₃ cannot be used as a specific test for potassium thiocyanate in the saliva in an aqueous solution. An ether extraction method is suggested.

Bunting, Russell W., 1914. THE SALIVA AND DENTAL CARIES. *Dent. Cosmos*, 56 (3): 285-294.

A study was made of the relation of the salivary composition and environment to dental caries. A discussion of the problems of salivary analyses and of the influence of dental plaques on caries is included.

Bunting, Russell W., and U. G. Rickert, 1915. DENTAL CARIES. *Jour. nation. [Amer.] dent. Assoc.*, 2 (3): 247-269.

Among the etiological factors of dental caries studied, salivary calcium determinations were made. The calcium values in 8 caries-immune individuals ranged from .0029 to .0042 mg. CaO/25 cc. saliva; in 4 caries-susceptible individuals, from .0017 to .0024; in 5 "indeterminates", from .0023 to .0030; in 50 women in various stages of pregnancy, from .0015 to .0035 (generally decreasing during the eighth month to .0015 to .0017); in 5 school children, from .0022 to .0037. Method of determination is described in full. It was observed that when calcium content was high, the dental enamel surfaces appeared more dense and opalescent. This was true so consistently that it became possible to roughly estimate the calcium content of saliva in an individual by the appearance of his teeth.

Bunting, Russell W., and Florence H. Wixon, 1917. DENTAL CARIES. *Jour. Amer. dent. Assoc.*, 4 (1): 81-96.

The chemical properties of saliva were examined in relation to their role in the etiology of dental caries.

The calcium content in 18 caries-immune individuals ranged from .0025 to .0035 g. CaO/25 cc. saliva; that of 12 caries-susceptible persons ranged from .0015 to .0028 g. CaO/25 cc. The salivary calcium content of 7 pregnant women was consistently below normal, ranging from .0015 to .0021 g./cc. No definite relationships were established, but it is concluded that the calcium content of saliva is independent of the amount ingested---daily administration of 45 grain doses of CaCl or calcium lactate for two weeks failed to produce an increase in calcium content. Nor is extensive tartar formation related to a high salivary calcium content---in each of several severe tartar cases, the salivary calcium content was below .0030 g. CaO/25 cc. saliva.

The acid-neutralizing power of 8 caries-immune subjects ranged from 13.34 to 33.84 in unstimulated saliva and from 19.40 to 51.56 in stimulated saliva. The salivary factor (the quotient of the acid-neutralizing power of stimulated divided by that of unstimulated saliva) ranged from 49.27 to 78.89, with one case of 105.00. This would be in agreement with the work of Marshall [cf. Marshall, J. A., 1915n and 1916m], who established a salivary factor of 80 as the critical caries factor above which caries was active and below which caries did not occur. The acid-neutralizing power of 12 caries-susceptible persons ranged from 14.46 to 35.96 for unstimulated saliva and from 25.46 to 42.80 for stimulated saliva; the saliva factor ranged from 52.14 to 89.18. In pregnant women, values were 5.46 to 29.90, and 17.99 to 44.66, respectively; the salivary factor ranged from 40.06 to 125.75. These values would not agree with Marshall's theory.

The acidity and alkalinity changes in saliva effected by various stimuli were observed. No differences between the reactions to acid or to alkali stimulation and to those of paraffin stimulation were observed.

Bunting, Russell W., 1924. DIET AND ITS RELATION TO THE PREVENTION OF DENTAL CARIES. *Jour. Amer. dent. Assoc.*, 11 (1): 64-75.

The author reviews the present knowledge of nutrition as it relates to the cause and prevention of dental caries.

In a discussion of the role of saliva and oral microorganisms in the cause of oral disease, the author states: "It is my opinion that it is not so much a case of specificity of bacteria as a specificity of media, i.e., the oral secretions and the retained foodstuffs, which determine the life history of the bacteria, their activity, and the type of oral disease which prevails. With this concept of dental disease in mind, we may visualize the effect of diet and of nutrition on the character of salivary secretions and, in turn, on the type of predominating bacterial activity in the composite mouth flora, which if acid forming, may produce caries, if proteolytic, may give rise to gingival disturbances and pyorrhea, or which may be wholly benign" (p. 73).

Bunting, Russell W., Gail Nickerson, and Dorothy G. Hard, 1926. FURTHER STUDIES OF THE RELATION OF BACILLUS ACIDOPHILUS TO DENTAL CARIES. Dent. Cosmos, 68 (10): 931-942.

A survey was made of the mouths of 427 persons, 184 of whom were considered immune to dental caries. Bacillus acidophilus [Lactobacillus a.] was isolated from the mouth of one of this immune group and from the mouths of 237 of the 243 persons showing evidences of dental caries. A drop in the frequency of occurrence of B. acidophilus in the oral flora was noted in persons over 20 years of age. A study of the effect of nitromersol mouthwashes on B. acidophilus showed a 1:10,000 solution of the substance generally to cause no appreciable diminution in numbers of the organism; stronger solutions coupled with prophylactic treatment of the teeth appeared more effective.

Bunting, Russell W., Gail Nickerson, Dorothy Hard, and Mary Crowley, 1928. FURTHER STUDIES OF THE RELATIONSHIP OF BACILLUS ACIDOPHILUS TO DENTAL CARIES. Dent. Cosmos, 70 (1): 1-8.

Examination of the mouths of over 1300 children was made to determine the presence of dental caries and of Bacillus acidophilus [Lactobacillus a.] A close correlation was found between the presence of the organism and active dental caries. Tests of the effectiveness of nitromersol showed the solution, used in conjunction with prophylactic dental measures, to inhibit growth of B. acidophilus. Analysis of the pH of saliva of a group, including both persons with and without dental caries as well as B. acidophilus in their oral flora, showed a distribution in pH value from 6.4 to 7.2 unrelated to incidence of caries or activity of B. acidophilus.

Bunting, Russell W., Mary Crowley, Dorothy G. Hard, and Margaret Keller, 1928a. FURTHER STUDIES OF THE RELATION OF BACILLUS ACIDOPHILUS TO DENTAL CARIES. Dent. Cosmos, 70 (10): 1002-1009.

Use of a hexylresorcinol solution as a mouth wash resulted in the disappearance of Bacillus acidophilus [Lactobacillus a.] from the oral flora in 24 of 36 subjects tested. This solution as well as that of nitromersol however were found variable in effectiveness, failing to inhibit growth of some strains of B. acidophilus in the mouth and in vitro. A report is also made on the influence of diet upon the presence of B. acidophilus and dental caries.

Bunting, R. W., F. P. Hadley, P. Jay and D. G. Hard, 1930. THE PROBLEM OF DENTAL CARIES. Amer. Jour. Dis. Child., 40 (3): 536-548.

The oral bacterial flora is considered to be more important than variations in salivary neutralizing powers. Caries is considered to be an infective disease and the causative agent to be Bacillus acidophilus (Lactobacillus a.). A study of the dietary coupled with the therapeutic method of control is given. The results indicate that the dietary program, a well balanced diet with minimal amounts of sugar and white flour, produced a definite inhibitory effect on the growth of B. acidophilus and hence on the incidence of caries. The therapeutic measures, which consisted of hexylresorcinol used daily as a mouthwash, were also effective although some variation in the susceptibility of certain strains of B. acidophilus was noted. Control of the diet appeared to be the more active inhibitive force of the two methods employed.

Bunting, Russell W., 1933. RECENT DEVELOPMENTS IN THE STUDY OF DENTAL CARIES. Science, 78 (2028), Nov. 10: 419-424.

A review is presented of research on dental caries which considers the proximal and constitutional factors in this disease. Dental caries, a bacterial disease of the oral cavity, is characterized by acid fermentations and a decalcification of the teeth; Bacillus acidophilus [Lactobacillus acidophilus] is usually present. Chemically, it was determined by the University of Michigan dental caries research group that no constant differences could be demonstrated in either the blood or the saliva of caries-susceptible individuals as compared to persons who were caries-resistant. The total calcium, the total phosphorus, and the pH of the blood and the saliva from individuals in the two groups showed no constant differences. Furthermore, there was no active bactericidal agent discovered in the saliva of the caries-resistant individuals; however, immunologic studies by the Michigan group of investigators have indicated that there is some form of general immunologic principle which controls the growth and the activity of Bacillus acidophilus in the mouth and intestinal tract of the caries-resistant individual. A protein diet results in a bacterial flora of the mouth which is chiefly proteolytic in nature; a carbohydrate diet, on the other hand, produces overgrowths of fermentative bacteria. Further studies of the chemistry of saliva and its immunologic reactions against Bacillus acidophilus seem to offer the greatest promise for the ultimate solution of this problem.

Bunting, Russell W., 1934. BACTERIOLOGICAL, CHEMICAL, AND NUTRITIONAL STUDIES OF DENTAL CARIES BY THE MICHIGAN RESEARCH GROUP. A SUMMARY. Jour. dent. Res., 14 (2): 97-105.

Studies are briefly summarized of the oral flora, the chemical constituents of saliva and of blood serum, and of nutrition in relation to dental caries.

Bunzell, H. H., 1923. ON THE TRUE ACIDITY OR ALKALINITY (HYDROGEN-ION CONCENTRATION) OF MIXED NORMAL HUMAN SALIVA AS OBTAINED FROM THE RESTING MOUTH. Colgate & Co., Bull. No. 1, 15 pp.

Colorimetric determinations were made of the pH of salivary samples from a number of male and female subjects of varying ages, and the resultant findings tabulated. The pH range was found to be from 6.0 to 6.64 with variations depending upon

the individual tested, the time of day, and age. No relationship was noted to exist between pH and the condition of the teeth.

It is concluded that the pH of saliva is slightly acid, but could be referred to as being of neutral reaction since it so closely approximates pH 7.0.

Bunzell, H. H., 1923a. THE COMPARISON OF SOAP-CONTAINING AND SOAP-LESS DENTIFRICES IN THEIR EFFECT ON THE REACTION OF SALIVA. Colgate & Co., Bull. No. 2, 45 pp.

Based on observations of male and female human subjects, findings indicate that all dentifrices produce an initial rise in pH (0.3 to 0.4) whether they are soapless (acid or alkaline) or soap-containing (alkaline), either applied by brushing or by rinsing. The initial rise in pH is temporary and returns to normal within 10 to 15 minutes. Data also indicates that hot (55 - 60°C) and cold (10 - 15°C) water produce a greater increase in alkalinity than water at body temperature.

It is concluded that the effects of soapless dentifrices, soap-containing dentifrices, chalk, soap alone, or foreign substances in solutions or suspensions have similar effects upon salivary pH, and that these effects are unimportant to dental hygiene.

Bunzell, H. H., 1924. "CURDLING" OF THE MUCIN IN THE SALIVA. Colgate & Co., Bull. No. 3, 21 pp.

In vitro experiments with human saliva were performed to test the mucin-coagulating power of organic and inorganic acids. Findings indicate that acetic acid (pH 3.0 to 1.5), hydrochloric acid (pH 4.19 to 1.8), the ortho-phosphoric acid can cause, under certain conditions, the curdling of salivary mucin. Calcium acid phosphate and calcium phosphate-hydrochloric acid, on the other hand, when introduced into salivary samples, show no curdling effects. Findings further indicate that saliva loses its coagulation power in 3 hours at room temperature.

It is concluded that acid dentifrices do not cause the precipitation or curdling of salivary mucin and that calcium salts prevent any coagulation that might take place.

Bunzell, H. H., 1924a. THE COMPARATIVE EFFECTS OF MILDLY ALKALINE AND ACID (SOAPLESS) DENTIFRICES AND CERTAIN FLAVORING MATERIALS ON THE FLOW OF SALIVA. Colgate & Co., Bull. No. 4, 16 pp.

In an attempt to test the effects of dentifrices on salivary flow, 12 acid (soapless) and alkaline dentifrices were used. Tabulations show that both acid and alkaline dentifrices, soap, chalk, and flavoring increase salivation. However, acid effects are more temporary than those caused by alkaline dentifrices. Hot and cold water, used as salivary stimulants, were shown to produce no greater flow than lukewarm water.

Burchard, Henry H., 1895. THE ORIGIN OF SALIVARY CALCULUS. Dent. Cosmos, 37 (10): 821-832.

Salivary calculi are considered to be formed by the action of lactic acid upon the secretions of the salivary glands and of the glands of the oral mucosa. A mucin coagulum is formed which

enmeshes some of the precipitated calcium salts. Increased or altered secretion of the glands may occur in folds marking the gingival border of the teeth where accumulation of fermentable material forms a food supply for microorganisms which produce the lactic acid.

Burchard, Henry H., 1898. VARIETIES OF DENTAL CALCULI. Dent. Cosmos, 40 (1): 1-9.

Five varieties of dental calculi, distinguished by pathological origin and chemical nature, are discussed. Calculi considered to be of salivary origin are deposits found on buccal surfaces of upper molars, calculi found on lower anterior teeth opposite the ducts of the submaxillary and sublingual glands, and calculi found immediately beneath the gum margin. Calculi considered to be of hematogenic origin are small nodular calculi found deep in pockets of pyorrhea cases or on root tips after long-continued apical abscess, and urate-containing deposits, on the sides of roots in cases of gouty necrosis of the pericementum.

Burghartz, N., 1952. ERGEBNISSE VON LYSOZYMBESTIMMUNGEN IM SPEICHEL BEI MAGENGESUNDEN UND MAGENKRANKEN [Results of lysozyme determinations in the saliva of healthy subjects and gastric patients]. Klin Wochenschr., 30 (11-12): 284.

A preliminary study is reported concerning 67 nephelometric determinations made of the lysozyme content of the saliva of healthy subjects and gastric patients. A significant difference was found between salivary values for the healthy subjects and for the gastric patients, most of whom were peptic ulcer cases. Graphic data show the healthy subjects to have 5 µg. of saliva per cc. of saliva while peptic ulcer patients had 40 µg. before treatment, 10 µg. after treatment, and 7 µg. during intervals.

Burlakova, E. V., I. V. Malkiman, V. M. Rubel', S. I. Filippovich, M. P. Apanasiuk, and G. V. Chernysheva, 1953. K VOPROSU O VYDELNI I RADIOAKTIVNOGO FOSFORA SO SLIŬNOŬ, ZHELUDOCNYM I PODZHELUDOCNYM SOKAMI [On the secretion of radioactive phosphorus by saliva and by gastric and pancreatic juices]. IN: TRUDY PO PRIMENENIU RADIOAKTIVNYKH ISOTOPOV V MEDITSINE, MOSCOW, p. 218-224. Abst.: Sovet. med. refer. Obozrenie, Fiziol., 1955 (22): 62.

The radioactive phosphorus content in salivary, gastric, and pancreatic secretions was studied in healthy dogs having parotid and submaxillary fistulae and in dogs with isolated ventricles. The general phosphorus content was measured using a Heiger-Muller recorder. Salivary secretion was stimulated by rusk, the radioactive phosphorus being injected after the start of secretion.

The P₃₂ usually appeared in the saliva 15 seconds later; at the end of the first hour the P₃₂ content reached a maximum, then gradually decreased during many days. The effect upon the gastric and pancreatic juices is described. A study of the acid-soluble and acid-insoluble phosphorus fractions showed the acid-insoluble fraction to appear in the digestive juices very rapidly after injection of the inorganic radio-phosphorus into the blood stream. This points to the important participation of the phosphor compounds in the metabolism of the above-mentioned digestive glands.

Burnet, F. M., Dora Lush, and A. V. Jackson, 1939. A VIRUS-INACTIVATING AGENT FROM HUMAN NASAL SECRETION. *Brit. Jour. exper. Pathol.*, 20 (5): 377-385.

Filtered human nasal secretion contains an antiviral agent capable of inactivating all types of influenza virus (Melbourne, W. S., Burr, and Swine 15) and the viruses of herpes, louping ill, and B virus, and probably the Rous sarcoma virus; the poliomyelitis virus was slightly affected, but the viruses of psittacosis, fowl-pox, vaccinia, ectromelia, infectious laryngotracheitis, and myxomatosis were unaffected. The agent is described as probably enzymatic in nature, most active at 36°C., and destroyed by boiling for 10 minutes. Human and cat salivas contained very small amounts of the substance, which was demonstrated to be distinct from Fleming's lysozyme.

Burnett, George W., and Henry W. Scherp, 1949. THE PROTEOLYTIC BACTERIA OF THE MOUTH AND THE CARIOUS LESION. *Jour. dent. Res.*, 28 (6): 638.

"Because proteolytic bacteria have been claimed to be the causative agent in dental caries, we have investigated the number, the kind, and the action of proteolytic bacteria found in (1) saliva, (2) enamel caries, and (3) superficial and deep dentin caries. From 144 cases we isolated, on coagulated egg medium, 250 strains of proteolytic organisms consisting most of aerobic gram-positive sporulating bacilli and gram-positive cocci, and a few gram-negative bacilli and cocci. A study of the proteolytic activity of these bacteria on gelatin, casein, coagulated blood serum, coagulated egg and decalcified dentin and enamel indicated a close correlation between their abilities to liquefy coagulated egg and to digest decalcified enamel and dentin. No anaerobic bacteria that could digest decalcified enamel and dentin were isolated. Aerobic bacteria that could liquefy decalcified dentin were almost completely absent from the saliva of individuals without open carious lesions, from enamel caries, and deep dentin caries, but were found in small numbers in the saliva of persons having open carious lesions. In the superficial layers of dentin caries, the proteolytic bacteria constituted 7 percent of the total flora. Intact enamel and dentin were subjected to the action of the liquefying bacteria in broth for periods up to five months with no apparent action. Because of this fact and because such proteolytic bacteria could not be found in the advancing carious lesion, their role as the causative agent of dental caries remains questionable." (Complete paper.)

Burnett, George, and H. W. Scherp, 1951. THE DISTRIBUTION OF PROTEOLYTIC AND ACIDURIC BACTERIA IN THE SALIVA AND IN THE CARIOUS LESION. *Oral Surg.*, 4: 469-477.

The distribution of proteolytic and aciduric bacteria in the saliva from carious and non carious mouths was investigated. Paraffin-beeswax stimulated saliva was collected and cultured on tomato juice agar, blood agar, milk agar, and coagulated egg medium under aerobic and sometimes anaerobic conditions. The saliva of 25 non-carious patients showed lactobacilli (*Lactobacillus acidophilus*) to constitute 0.032 percent of the total count which had a mean of 12,000,000 colonies per ml.; other aciduric bacteria made up 0.011 percent,

ovolytic bacteria were essentially absent, and caseinolytic bacteria constituted 3.8 percent of the total cultivable flora. The saliva of 34 patients with caries showed a slight increase in the total number of bacteria, the mean in these cases being 15,700,000 colonies per ml. Lactobacilli made up 0.39 percent of the total count, other aciduric bacteria made up 0.05 percent, ovolytic organisms 4.5 percent.

Burnett, George W., 1952. THE RESPIRATION RATE OF HUMAN SALIVA. *Jour. dent. Res.*, 31 (4): 468-469.

"The respiration rate of stimulated saliva from 34 humans has been determined by conventional manometric techniques. The relationship of the respiration rate to lactobacilli counts, acid producing potential, amylase activity and fluorides was investigated. The respiration rate of saliva from different individuals varied over a wide range but was relatively constant for each individual from week to week. The respiration rate of whole stimulated saliva was not correlated with lactobacilli counts but, in several cases, a high respiration rate was associated with freedom from caries. The addition of mono-, di-, and polysaccharides to saliva in vitro increased low respiration rates more than it did high respiration rates. The acid producing capacity of various salivas varied considerably when acting on different carbohydrates. Many salivas produced more acid from polysaccharides (starch) than from mono- and disaccharides. This phenomenon was not directly correlated with the basic respiration rate but apparently depended, in part, upon the amylolytic activity of the individual saliva. Low concentrations (5 parts per million or less) of various simple and complex fluorides did not appreciably lower the respiration rate of saliva in vitro. High concentrations of fluorides (200 parts per million) lowered the basic respiration rate of saliva but did not suppress it. Fluorides lowered the respiration rate of saliva to which carbohydrates had been added more than it did saliva to which no carbohydrates had been added." (Complete paper.)

Burnett, George W., 1953. THE EFFECT OF CARBOHYDRATES AND INHIBITORS ON THE RESPIRATION RATE OF HUMAN SALIVA. *Jour. dent. Res.*, 32 (5): 640.

"The relationship of the oxygen consumption of whole, stimulated human saliva to the addition of mono-, di-, and polysaccharides and inhibitors has been investigated by manometric methods. The average basic oxygen consumption of the salivas of forty-four individuals varied between 1.14 and 4.70 l. per minute. The basic oxygen consumption of cannulated parotid saliva was very low, while that of whole saliva was inhibited by Seitz-filtering, high speed centrifuging, boiling, and treatment with cyanide or strong mineral acid. The addition of 2 percent glucose to whole saliva of ten individuals gave results ranging from no stimulation of oxygen consumption to an increase of 66.1 percent over normal, with a mean increase of 29.1 percent. The addition of 2 percent starch to such salivas gave results ranging from no stimulation of oxygen consumption to a maximum increase of 38.6 percent, with a mean increase of 16.2 percent. The addition of 1 to 5 ppm NaF to whole salivas did not decrease their oxygen

consumption significantly, but the addition of 200 ppm caused an average decrease of 6 percent. The mean percentage increase in oxygen consumption of these salivas plus 2 percent glucose plus 200 ppm NaF was 19 percent; the increase for the salivas plus 2 percent starch plus 200 ppm NaF was 12.6 percent. Concentrations of sodium fluoride, lead fluoride, calcium monofluorophosphate, and potassium monofluorophosphate ranging from 1.0 to 1.4 percent effectively inhibited oxygen consumption of whole saliva, while similar concentrations of calcium fluoride did not do so." (Author's abstract)

Burnett, George W., 1954. STUDIES ON THE RESPIRATIONS OF THE MICROBIAL FLORA OF HUMAN SALIVA. *Jour. dent. Res.*, 33 (4): 469-480.

Ten ml. samples of whole, paraffin-stimulated saliva were collected from individuals found to belong to 1 of 4 groups: caries-susceptible, moderately caries-susceptible, slightly susceptible, or not susceptible. The salivary samples were allowed to equilibrate with air for 10 minutes, each 1.8 ml. portion of the sample was then buffered with 1 ml. of a M/50 phosphate buffer at pH 7.1, the oxygen consumption being determined at 37.5°C.

Results showed that partial removal of the salivary flora, by centrifugation of the saliva for 1 hour at 4000 rpm, caused a reduction of 85.9% in O₂ consumption occurring in an undisturbed aliquot of the same saliva over the same 1 hour period, a drop from 196.8 ml. of O₂ to 27.8 ml. Sterile, Seitz-filtered saliva was found to utilize 14.5 ml. of O₂ during 74 minutes whereas a similar, non-filtered portion consumed 223.4 ml. Similar tests using saliva from a *Macacus rhesus* monkey showed sterile, cannulated parotid saliva to utilize 6.5 ml. of O₂ compared to 184.8 ml. over the 90-minute test period for whole saliva.

Tests of various bacterial inhibiting agents on 2 ml. portions of a 12 ml. sample of human saliva, showed heating to 100°C for 1 hour, addition of 0.2 ml. of 1M sodium cyanide, or of 1M H₂SO₄, effectively inhibited oxygen consumption; addition of 1.6% sodium fluoride decreased the consumption 78%; addition of 200 ppm of fluorine (NaF) produced only a slight, temporary inhibition in O₂ consumption. Comparison of the O₂ consumption of the microbial flora in the salivas of a caries-susceptible and a caries-resistant individual showed greater variation in rate of consumption from day to day in the saliva of the caries-resistant individual who also showed a significantly lower mean rate of consumption. Comparison of oxygen consumption rates of individuals in the four groups showed significant differences in rates between individuals but not between groups. The addition of carbohydrates to the saliva in vitro caused an increase in the respiration rate with insignificant differences noted between the effects of starch and of glucose. In the presence of 2% carbohydrate a concentration of 200 ppm of fluoride had a moderately depressing effect on O₂ consumption. Tests of various types of fluorides in final concentrations of 1.6% (NaF, CaF₂, PhF₂, Ca₂, PO₃F) in the salivas of 2 individuals showed all but calcium fluoride to effectively inhibit the O₂ consumption of the microbial flora of the saliva. It is concluded that the viable microbial flora of whole, paraffin-stimulated saliva is principally responsible for the respiration rate of the saliva.

Burrill, D. Y., J. C. Calandra, E. B. Tilden, and L. S. Fosdick, 1945. THE EFFECT OF 2-METHYL-1, 4-NAPHTHOQUINONE ON THE INCIDENCE OF DENTAL CARIES. *Jour. dent. Res.*, 24 (6): 273-282.

Study was made in 58 individuals of the effect of 2-methyl-1, 4-naphthoquinone-sodium bisulfite addition compound (synthetic vitamin K) when added in 75 mg. amounts to the sugar coating of commercial chewing gum which contained a calcium carbonate filler. The gum was chewed for 10 minutes after each ingestion of food over an 18-month period by the subjects chosen as having more than average caries susceptibility, 12 unfilled proximal tooth surfaces likely to decay, a lactobacillus count of 50,000 or more, and a 2 plus or greater chemical susceptibility. A similar group of 45 individuals used the gum containing the calcium carbonate filler but not vitamin K.

Bacteriological and chemical tests, made in each subject before and during the experimental period, usually showed a rapid initial drop in numbers of *Lactobacillus acidophilus* accompanied by a less pronounced drop in the enamel-dissolving power of the saliva within a week after start of the gum chewing. Both bacterial count and enamel-dissolving power then showed a steady rise which seldom reached or exceeded pre-gum values. Comparison of dental caries data from the two experimental groups and from a group of non-participants showed use of the vitamin K gum to reduce occurrence of new cavities 60 to 90%, while use of the gum containing only calcium carbonate reduced incidence of new caries one half of this amount. The calcium carbonate is considered to act as an acid neutralizer while the vitamin K acts as an enzyme inhibitor.

Burstone, M. S., 1953. A HISTOCHEMICAL STUDY OF NORMAL AND IRRADIATED SALIVARY GLAND TISSUE IN THE MOUSE. *Anat. Rec.*, 115 (3): 543-557.

A histochemical study was made of the effect of local irradiation of the sublingual and submaxillary glands of 20 mice, 2 days old. Radioactive chromic phosphate (containing P₃₂) was injected subcutaneously to irradiate the glands. The animals were sacrificed 7 days after the injection. The periodic acid-Schiff method (pa-S) was used to study protein-carbohydrate complexes and glycogen. Results showed that the irradiated glands stained less intensely than the controls, with the submaxillary gland showing a much greater decrease in stainability than the sublingual gland. Both glands exhibited an increase in the water solubility of pa-S positive components. It is suggested that the results indicate that a greater radiosensitivity is exhibited by the submaxillary gland than by the sublingual gland.

Bussard, A., R. Bequignon, and R. Lamy, 1949. CONTRIBUTION A L'ÉTUDE DE LA RAGE. III. DE LA PRESENCE DE HYALURONIDASE DANS LA BAVE DE CHIEN NORMAL [Contribution to the study of rabies. III. On the presence of hyaluronidase in the saliva of the healthy dog]. *Ann. de l'Inst. Pasteur*, 77 (2): 183-185.

The saliva of 14 healthy dogs was examined for the presence of hyaluronidase. Salivary flow was stimulated by injection of 0.05 g. pilocarpine. 5 to 10% saliva was added to a 3% solution of hyaluronate of ammonium in a citrate buffer (pH 4.7). Reduction of a viscosity served as a

test of hyaluronidase activity. Viscosity measurements were made every minute for 15 minutes with both an Ostwald viscosimeter and a viscosimeter of Lecomte du Nouy, Choix, and Verain, and a good correlation was noted between the two series of measurements.

With two exceptions, the presence of hyaluronidase was established. The activity ranged from 6 VRU (units of viscosity reduction) to 154 VRU. Boiling of saliva for 5 minutes completely destroyed the enzymatic activity. Storage of samples at 5°C. seemed to cause a lowering of activity. No correlation appeared to exist between age and hyaluronidase activity. It seemed, however, that hyaluronidase of male saliva was more active than that of the saliva of females.

Previous work had shown that the "fixed virus" of rabies was not infectious to guinea pigs when introduced alone subcutaneously. Addition of normal saliva or of testicular hyaluronidase to the virus produced infectivity. The author concludes that the hyaluronidase contents of saliva render the saliva of diseased dogs infectious by permitting the virus to diffuse through the connective tissue to the nerve terminations.

Buttner, W., and J. C. Muhler, 1957. EFFECT OF VARYING LEVELS OF DL-TRYPTOPHAN IN DIET ON DENTAL CARIES IN RATS. *Proc. Soc. exper. Biol. Med.*, 95 (2): 309-311.

Three of four groups comprising 120 weanling Sprague-Dawley strain rats fed a cariogenic diet, received diet supplements of DL-tryptophan varying from 0.6 to 5.4 gm./kg. diet for a period of 110 days. The fourth group served as controls. analysis of salivary samples, collected after intraperitoneal injection of 10 mg./gm. body weight of pilocarpine hydrochloride in the rat under sodium nembutal anesthesia, showed significant increases in salivary tryptophan levels with increase in dietary tryptophan concentration. These increases were accompanied by increases in incidence of dental caries.

Buttner, W., and J. C. Muhler, 1958. EFFECTS OF SALIVARY FLUORIDE ON ENAMEL SOLUBILITY. *Jour. dent. Res.*, 37 (1): 58.

Several authors have reported a wide range in the fluorine level of human salivas (5 μ g to 74 μ g F per 100 ml.), which seems to be independent of the amount of fluorine ingested in water and food. Because fluorine values in the saliva of caries-resistant individuals tended to be higher, it was assumed that salivary fluorine levels greater than 25 μ g F per 100 ml. might inhibit caries. Laboratory evidence was obtained concerning the effect of salivary fluoride on enamel solubility. Sodium fluoride was administered at a level of 1 mg. F daily for 3 weeks to 3 groups of weanling rats either in the drinking water, by stomach tube, or intraperitoneally, respectively. In each group, one-half of the animals were desalivated. The acid solubility of intact molar teeth of the rat indicates a 25 percent reduction of enamel solubility of the group receiving fluoride containing drinking water whether the rats were desalivated or not. If fluoride was provided by stomach tube or intraperitoneally, the reduction of enamel solubility ranged from 25 to 40 percent in the nondesalivated rats. No significant reduction was found in the desalivated rats of these groups. (Author's abstract)

Buttner, W., and J. C. Muhler, 1958. THE EFFECT OF FEEDING CALCIUM PHOSPHATE SALTS WITH DIFFERENT SOLUBILITIES ON DENTAL CARIES, THE COMPOSITION OF THE SALIVA, AND THE FEMURS OF RATS. *Jour. dent. Res.*, 37 (5): 860-864.

Dietary tests in 135 weanling Sprague-Dawley strain rats were conducted for 120 days using a cariogenic diet. Analyses of salivary samples, collected after intraperitoneal injection of 10 mg./gm. body weight of pilocarpine hydrochloride in the rat under sodium nembutal anesthesia, showed that administration of 1% or 5% dicalcium-phosphate dihydrate, or calcium pyrophosphate, in daily feedings did not significantly alter the salivary calcium or phosphorus levels. A tendency was noted for less salivary calcium in the group receiving 5% calcium pyrophosphate, and more phosphorus in each of the calcium phosphate-supplemented groups when compared to controls.

Cahane, M., 1933. INFLUENCE DE LA GLANDE PAROTIDE SUR LE MÉTABOLISME HYDROCARBONÉ [The influence of the parotid gland on hydrocarbon metabolism]. *Compt. rend. Soc. Biol. (Paris)*, 112: 1438-1441.

The effect of extirpation of the parotid glands on glycemia was studied in 4 dogs over a 10-month period. No change in glycemia was observed in 2 dogs after removal of the glands while in the other 2 animals drops in glycemia of 0.14 to 0.24/1000 were noted. Ingestion of 50g. of glucose (or subcutaneous injection of 40-60 cc. of a 20% glucose solution) was followed, in these dogs prior to operation as well as in two controls, by a marked increase in glycemia which returned to normal 3 to 4 hours later. Little or no change in glycemia was noted on administration of glucose in the dogs after removal of the parotid glands. It is suggested that the parotid gland has an internal secretion, antagonistic in its effect to the internal secretion of the pancreas.

Calandra, J. C., O. E. Fancher, and L. S. Fosdick, 1944. THE EFFECT OF SYNTHETIC VITAMIN K AND RELATED COMPOUNDS ON THE RATE OF ACID FORMATION IN SALIVA. *Jour. dental Res.*, 23 (1): 31-37.

The action of various quinones and derivatives, and certain other compounds, which affect the oxidation-reduction systems involved in the formation of acids by fermentation, was tested for their effect on acid production in saliva. The experimental procedure was the same as previously reported (cf. Fancher et al., 1944m).

The following compounds were tested: 1,4-quinone; hydroquinone; 2-methyl-1,4-naphthoquinone; vitamin K₁; "menadione sodium bisulfite"; Hykinone (the sodium bisulfite addition compound with 2-methyl-1,4-naphthoquinone); Synkayvite (tetrasodium-2-methyl-1,4-naphthohydroquinone phosphate); 2,3-dichloro-1,4-naphthoquinone; 2-methyl-1,4-naphthohydroquinone; 2-methyl-1,4-naphthohydroquinone diacetate; potassium 2-methyl-1,4-naphthohydroquinone-3-sulfonate; Styptavite (a 2-methyl-1,4-naphthoquinone salicylic acid mixture or complex); citrinin; l-cystine; alloxan; sodium malonate; ethyl malonate; sodium maleate; morpholine; p-aminophenylglycine; hydrogen peroxide; sodium carbonate peroxide; urea peroxide; magnesium peroxide; and urethane.

All the derivations of quinone were effective in inhibiting acid formation. Synthetic vitamin K (2-methyl-1,4-naphthoquinone) was found to be equal to any of the compounds tested, and superior to most of them. In addition to the quinones and derivatives, the various peroxides were particularly effective in inhibiting acid formation.

Calandra, J. C., and L. S. Fosdick, 1947. THE EFFECT OF AMINO ACIDS ON THE RATE OF ACID FORMATION IN SALIVA. *Jour. dental Res.*, 26 (4): 303-308.

Seventeen amino acids were studied for effect on acid production in saliva-enamel-glucose mixtures. The difference in calcium contents of the controls and of the tests was indicative of the amount of acid formed. Only norleucine, phenylalanine, threonine, and valine inhibited acid production, but the high concentrations required indicated that they are probably not the cause of acid inhibition in saliva.

Calandra, J. C., and L. S. Fosdick, 1949. DEHYDROGENASES IN SALIVA. *Jour. dental Res.*, 28 (6): 666.

"It was recently shown that the reductase activity of saliva is a function of caries activity. The method of determining the dehydrogenase activity gave no indication as to the specific dehydrogenases present. This paper describes an attempt to determine the source of dehydrogenases in saliva. The method used was to test the oxygen uptake of specific substrates in the presence of saliva. To date the following substances have been shown to be active substrates: glucose, hexose diphosphate, lactic acid, dl-glyceric aldehyde, d-glycine, d-methionine, l-cystine, d- and l-norleucine, d-alanine, d-valine, l-histidine, l-arginine, l-glutamic acid, dl-lysine, dl-aspartic acid, sodium pyruvate, sodium stearate, and sodium palmitate." (Complete paper.)

Calandra, J. C., and Ernest C. Adams, Jr., 1950. THE INHIBITION OF ACID FORMATION IN THE MOUTH BY AMINO DERIVATIVES OF 2,3-DICHLORO-1,4-NAPHTHOQUINONE. *Jour. dental Res.*, 29 (5): 593-595.

Employing the usual method of taking free calcium in saliva as an index of acid formation, a study was made of the inhibitory properties of four amino derivatives (amino-pyridines, sulfonamides, alkylamines, and amino acids) of 2,3-dichloro-1,4-naphthoquinone on the acid production in the mouth. The sulfonamides effected the greatest inhibition. The pyridine derivatives were effective at their maximum concentration, but not in lower concentrations.

Calandra, J. C., and Ernest C. Adams, Jr., 1951. OXIDATION OF GLUCOSE DEGRADATION PRODUCTS IN THE PRESENCE OF SALIVA AND POSSIBLE RELATION TO CARIES IMMUNITY. *Jour. dental Res.*, 30 (2): 229-234.

The rates of oxidation of salivary lactate, pyruvate, acetate, and propionate were measured using a Warburg respirator. The oxygen uptake for pyruvate was 0.5 micromoles per hour per milliliter of saliva; for acetate, 0.78; for lactate, 6.9; and for propionate, 0.23 micromoles.

A discussion of a possible relation of these oxidations to natural immunity against caries is presented.

Caldwell, R. C., 1958. THE ADHESION OF FOOD-STUFFS TO TEETH. *Jour. dent. Res.*, 37 (1): 72-73.

Food mixtures of corn flakes, caramel, bread, etc., have been prepared in vitro by mixing with saliva or water in tensile strength tests of food to tooth enamel bonds. The same foods have been removed from tooth surfaces in vivo after chewing and the different values for adhesion noted. Some representative values reveal that after chewing corn flakes, the material as it is swallowed has very little adhesion (1 lb./sq. in.) while the material removed from the teeth has considerable adhesion (6.8 ± 2.0 lb./sq. in. to 9.6 ± 2.9 lb./sq. in.). Saliva-corn flakes mixtures in the in vitro tests (which measure the adhesive value of such mixtures used to "glue" two flat enamel surfaces together) have less adhesion to enamel than water-corn flakes mixtures at the same dilutions. Caramel soaked in water for 2 minutes has slightly less adhesion than when soaked in saliva (9.8 ± 1.1 lb./sq. in. vs 11.1 ± 0.7 lb./sq. in.). Caramel removed from the teeth in vivo had a value of 9.5 ± 0.9 lb./sq. in. The apparatus is being used to evaluate the effectiveness of organo-silicon, organophosphorus, and organotitanium treatments

to enamel surfaces intended to reduce the adhesion of foods to teeth. (From author's abstract)

Calonijs, P. E. B., 1958. THE LEUKOCYTE COUNT IN SALIVA. Oral Surg. Oral Med., Oral Pathol., 11 (1): 43-46.

Determinations were made of the leukocyte count in diluted, 0.01 cc. portions of 5 to 10-minute samples of whole, unstimulated saliva collected from subjects having clinically healthy mouths with and without teeth, and from subjects having inflamed and carious oral conditions. Mean leukocyte counts ranged from 1 to 143 cells/.01 cc. in the 25 subjects of the edentulate group, from 110 to 1364 cells/.01 cc. in the 18 normal subjects, and from 770 to 11,896 cells/.01 cc. in the 13 subjects with clinically inflamed mouths. Group differences cannot be attributed to daily variations.

Calvin, Jos. K., and B. L. Isaacs, 1925. STUDIES ON THE SALIVARY UREA INDEX IN CHILDREN. Amer. Jour. Dis. Child., 29 (1): 70-77.

The salivary urea index was determined in 196 children, ranging in age from 2-1/2 to 16 years: 85 had normal urines, 111 had albumin in the urine, of which ten had definite evidence of nephritis. The lowest normal index was 23; the upper index was 50, and the average 35. Of the ten children with marked nephritis, four had a normal salivary index ranging from 34-38 and six showed a high index from 60 to 105, denoting urea retention, which was confirmed by blood studies. The results of the investigation lead the authors to conclude that there is a distinct correspondence between the salivary urea index and the blood urea value, and that the salivary index definitely indicates the presence or absence of urea retention in the body.

Cameron, A. T., and J. S. Guthrie, 1941. TESTS FOR THE PRESENCE OF THE CHORIONIC GONADOTROPIC HORMONE IN THE SALIVA OF PREGNANT WOMEN. Trans. roy. Soc. Canada, Ser. 3, 35, Sect. 5: 31-33.

The salivas of 10 pregnant women, including 3 cases of threatened abortion, were tested for the presence of chorionic gonadotrophic hormone. No detectable amounts were found, using the Friedman and the Aschheim-Zondek tests with filtered saliva.

Cameron, Hazel C., 1935. SALIVARY SECRETION AND THE PHYSIOLOGICAL MECHANISM OF AVITAMINOSIS-A. Amer. Jour. Physiol., 115 (1): 210-214.

Salivary fistula were prepared in two dogs, a male and a female, as a means of observing any changes which occurred during progressive avitaminosis-A in the gland. The animals were placed on a biscuit diet, specially prepared to eliminate vitamin A, with free access to water. Salivary secretion, stimulated by subcutaneous injections of pilocarpine, was measured for 3 successive 10-minute periods in the morning, daily or every other day. For the first 2 weeks, in order to establish a norm for each dog, salivary secretion and water consumption were measured while the animals were given a carotene supplement to their biscuit diet. For 5 months after this period, the dogs received no vitamin A. The salivary secretion and the water consumption rose slightly at first, then there followed a fall to normal

or below. The author feels that the variation in salivary flow was too slight to have any significance, indicating that the peripheral salivary mechanism did not suffer appreciably in avitaminosis-A. Powdered dog-food was used in place of the pilocarpine on certain days as a stimulus for salivary flow. No significant change occurred. Changes in the salivary secretion of the dogs during the experiment were too slight to serve as an index to circulatory or secretory changes occurring during the avitaminosis-A. On the days when pilocarpine was given, a temporary central stimulation was suggested rather than a dehydrating effect inasmuch as a statistically significant temporary increase in water consumption followed by a decline to normal took place, and the salivary secretion was not lessened.

Cameron, Hazel C., 1936. SALIVARY SECRETION AND THE PHYSIOLOGICAL MECHANISM OF AVITAMINOSIS-A. Amer. Jour. Physiol., 115 (1): 210-214.

Insignificant changes of the amounts of saliva secreted with and without pilocarpine injections were observed in 2 dogs in progressive stages of vitamin-A deficiency.

Canby, C. P., and J. L. Bernier, 1942. BACTERIOLOGIC AND IMMUNOLOGIC STUDIES IN DENTAL CARIES: A PRELIMINARY REPORT. Jour. Amer. dental Assoc., 29 (4): 606-617.

An extensive review of literature data on dental caries, combined with the author's own experimental studies on the antigenic behavior of 24 strains of Lactobacillus acidophilus (isolated from carious dentin) and on the quantitative results of vaccination with L. acidophilus bacterin on this organism in the oral cavity. In 19 of 20 patients, a reduction in numbers of L. acidophilus occurred in the oral cavity following vaccination of the persons with vaccines prepared with strains of the same organism, indicating the production of a substance inhibitory to L. acidophilus.

An inverse relationship was seen between the reduction in bacterial numbers and an increase in agglutinin titer.

Canby, C. P., and J. L. Bernier, 1942a. BACTERIOLOGIC AND IMMUNOLOGIC STUDIES IN DENTAL CARIES: A PRELIMINARY REPORT. Jour. Amer. dent. Assoc., 29 (4): 606-617.

Thirty one strains of Lactobacillus acidophilus were cultured, aerobically and anaerobically, from dental caries of 14 extracted teeth; three types of colonies were recognizable. In order to prepare antigens, anaerobic cultures were isolated because of their greater stability of colony form and structure, their contancy of fermentation reactions in test sugars (pH 6.1), and their abundance of growth and lesser dissociability on tomato-agar.

Rabbits were intermittently injected with the antigen preparation until a 1:2,560+ titer was reached, and the sera of the animals were tested against 24 antisera. Cross agglutination data revealed that over half of the strains tested were serologically related. Guinea pig and rabbit injections of all vaccinal strains produced (in various dilutions) abscess formation at the injection site, and the irritating factor responsible for the lesion was found to

be due to an inherent property of the bacterial cell. All organisms tested were antigenic.

Guinea pigs were used for the standardization of the vaccine since such animals are more susceptible to skin reactions than are rabbits. The injection solution was prepared from strains killed by heat (1 hour at 56°C) and preserved in 0.5% phenol; 450×10^9 treated organisms contained in 1 cc. of the standard solution was used for human and guinea pig injections in concentrations (0.5 - 1.0 cc.) which would not produce skin reactions. Caries-susceptible persons were used in the study, and the saliva of each individual was tested before the initial vaccination and at regular intervals thereafter to determine the number of *L. acidophilus* per cc. Saliva was collected approximately three and a half hours after breakfast every day. "Dilute" vaccine (0.5 cc.) was employed in the initial injections and if no skin reactions occurred 1.0 cc. ("concentrated" vaccine) was administered. During the test period the number of injections was increased from once every five days to every three days.

Tabulations indicated that there was a difference in the salivary *L. acidophilus* counts before and after vaccination, after antigen administration the trend being toward a reduction in the number of organisms in 19 of the 20 subjects. In most cases the agglutination titer of the serum increased after vaccination. Oral hygiene was not controlled during the experiment except for the brushing of teeth after breakfast.

Cannon, Walter B., and George Higginson, 1918. THE PHYSIOLOGICAL BASIS OF THIRST. Proc. roy. Soc. London, (B) 90 (629): 283-301.

An extensive review of the literature on saliva in relation to the physiology of thirst is presented as an impetus to further investigations along this line.

The author distinguishes between "false" and "true" thirst--the former being simply a relative drying of the mucosa of the oral cavity and pharynx due to local causes such as excessive use of the passage for breathing, singing, speaking, or even deficient salivary secretion;--the latter, indistinguishable from the former as far as sensation is concerned, is dependent on the fact that the salivary glands require water for their action, and a thirst due to a lack of this water is indicative of a generalized bodily demand for fluid.

Cannon, W. B., and Z. M. Bacq, 1931. STUDIES ON THE CONDITIONS OF ACTIVITY IN ENDOCRINE ORGANS. 26. A HORMONE PRODUCED BY SYMPATHETIC ACTION ON SMOOTH MUSCLE. Amer. Jour. Physiol., 96 (2): 392-412.

In studies on a chemical substance given off from smooth muscle under the influence of sympathetic impulses, cats were subjected to unilateral sympathetic denervation of the submaxillary gland, removal of one adrenal gland and denervation of the other. About 10 days later the submaxillary duct was cannulated and the spinal cord transected at the seventh thoracic vertebra. A few hours later, with the animal under curare and the effects of a pilocarpine injection (1 cc. of 0.1%) wearing off, stimulation of sympathetic nerves of the tail resulted in a striking increase in salivary

secretion. Similar results were obtained on stimulation of the superior mesenteric artery after removal of the remaining adrenal gland, as well as on stimulation of nerves arising from the inferior mesenteric ganglion. Closure of the aorta above the celiac axis for 30 seconds indicated that the increased rate of salivation was not due solely to a higher blood pressure and increased volume flow of blood to the secreting gland. A hormone, termed sympathin and allied to adrenin, is postulated as the substance given off by smooth muscle when acted upon by sympathetic impulses.

Cannon, Walter B., and Arturo Rosenblueth, 1937. AUTONOMIC NEURO-EFFECTOR SYSTEMS. New York, MacMillan, 229 p.

Contained and discussed in this monograph are the neuro-chemical findings on resultant functional reactions of effector organs (smooth muscles, cardiac muscle, and glands, including the salivary glands), of their neuro-junctional regions, and of their autonomic innervations.

Carles, J., and P. Delmas-Marsalet, 1924. VARIATIONS DU POUVOIR AMYLOLYTIQUE DE LA SALIVE AU COURS D'ÉTATS PATHOLOGIQUES DIVERS [The variations of amylolytic power of saliva in the course of various pathological states]. Compt. rend. de la Soc. de Biol. (Paris), 91 (20): 42-44.

Human saliva, stimulated by placing salt on the tongue, was collected from healthy subjects and from two general classes of sick persons, those with general infections or cachexia and those with gastric disturbances. A comparative study of the amylolytic power of these salivas indicated a lessening of the power in subjects with general infections. Among those with gastric disturbances, variations in the amylolytic power somewhat paralleled variations in gastric chemistry [acidity?].

Carlson, A. J., J. R. Greer, and F. C. Becht, 1907. ON THE MECHANISM BY WHICH WATER IS ELIMINATED FROM THE BLOOD IN THE ACTIVE SALIVARY GLANDS. Amer. Jour. Physiol., 19 (3): 360-387.

A series of 13 experiments were carried out on the dog to study the effects of submaxillary gland activity on the flow of lymph from neck lymphatics and to compare the osmotic pressure of this lymph with that of the blood serum. A series of 9 experiments were carried out on the horse to compare osmotic pressures of lymph from neck lymphatics and from the parotid gland, with that of blood serum.

Spontaneous flow of lymph in the neck was observed in 7 of 9 horses while the parotid gland was at rest and in all measurements on the dog, unless blood pressure was low.

No relationship was established between activity of the salivary gland of the dog or horse and output of lymph. In all but two of the experiments on the dog, serum was observed to have a higher osmotic pressure than lymph. No constant relationship between the osmotic pressure of parotid lymph of the horse and that of its blood was observed.

Carlson, A. J., J. R. Greer and F. C. Becht, 1907b. THE RELATION BETWEEN THE BLOOD SUPPLY TO THE SUBMAXILLARY GLAND AND THE CHARACTER OF THE CHORDA AND THE SYMPATHETIC SALIVA IN THE DOG AND CAT. Amer. Jour. Physiol., 20 (1): 180-205.

The composition of the saliva produced by stimulation of the chorda tympani and of cervical sympathetic nerves was studied in a series of 5 experiments.

A drop in total solids content was observed in dog saliva elicited by a second chorda stimulation that immediately followed a first. Saliva produced thereafter by stimulation of the cervical sympathetic nerve showed an increase in concentration.

A second series of experiments (7 dogs, 2 cats) in which the arterial blood supply to the gland was reduced during chorda stimulation approximately to the blood supply during sympathetic stimulation, showed that the quantity and rate of secretion, and the concentration of solids were equivalent. Analysis showed that this increase in solids was mainly due to the increased percentage concentration of organic constituents. Stimulation of the chorda immediately after occlusion of the artery caused a temporary drop in blood output of the gland veins. Spontaneous saliva, produced after restoration of the normal circulation, was poor in both organic and inorganic solids.

Attempts to separate the secretory and vasomotor fibers of the cervical sympathetic nerve of 4 dogs by the degeneration method were unsuccessful. Simultaneous stimulation of the chorda after paralysis of the chorda secretory fibers by atropin gave inconclusive results. Attempts to perfuse defibrinated dog or ox blood, Locke's solution under oxygen pressure, or Locke's solution plus oxygenated dog blood corpuscles failed. Although the sympathetic action was counteracted the gland became oedematous very quickly. Attempts to reverse circulation in the dog's submaxillary gland also failed to yield conclusive results.

Carlson, A. J., J. R. Greer, and F. C. Becht, 1907c. ON THE MECHANISM BY WHICH WATER IS ELIMINATED FROM THE BLOOD CAPILLARIES IN THE ACTIVE SALIVARY GLANDS. *Proc. Soc. exper. Biol. Med.*, 4 (6): 131-134.

"1. There is a spontaneous flow of lymph from the quiescent parotid gland of the horse. The quantity is never great but it was evident in all of our nine experiments ... 2. When the parotid of the horse is thrown into activity by stimulation of the cranial secretory nerves or by injection of pilocarpin into the blood there is no appreciable increase in the output of lymph from the gland as compared with that from the gland at rest. This is true both of the spontaneous flow and the flow aided by direct massage of the gland ... 3. The activity of the submaxillary does not appreciably influence the flow of lymph from the neck lymphatic in the dog. This conclusion is based on experiments on thirteen dogs ... 4. In dogs under light ether anesthesia, perfectly quiescent and with all the salivary glands at rest, there is always a spontaneous flow from the neck lymphatics. If the anesthesia is pushed till the blood pressure falls considerably, this spontaneous flow ceases ... 5. The osmotic pressure of the lymph from the active parotid of the horse is not the same in all animals. It may be either the same, higher or lower than that of the serum. In fact in three out of five experiments it was lower. In four of the experiments we failed to

secure sufficient quantities of lymph from the gland for the freezing point determination. Since we have only five experiments on which to base our deductions, we do not consider the above statements final; but the fact that the lymph obtained from the active gland had in three cases considerably lower osmotic pressure than the serum, apparently eliminates osmosis as the factor effecting the transfer of water from the blood capillaries in the active gland. That leaves the secretory nerve theory and the 'hormone' theory, as before stated, the only occupants of the field. The latter seems to us the most probable one, and our work is now directed towards proving or disproving it ... 6. The osmotic pressure of the lymph from the neck lymphatics of the horse, collected with the animal under chloroform anesthesia, maybe of slightly higher, of the same or of considerably lower osmotic pressure than the serum ... 7. The osmotic pressure of the lymph from the neck lymphatics of the dog is usually lower than that of the serum. It is rarely greater ... 8. Under the conditions of our experiments--ether or chloroform anesthesia for from two to four hours--the osmotic pressure of the serum at the end of the experiment was in many cases greater than at the beginning of the experiment. The same difference is sometimes exhibited by the lymph collected from the same lymphatic but at different periods of the experiment ..." [From the original paper]

Carlson, A. J., 1907a. VASO-DILATOR FIBRES TO THE SUBMAXILLARY GLAND IN THE CERVICAL SYMPATHETIC OF THE CAT. *Amer. Jour. Physiol.*, 19 (3): 408-416.

Investigations showed that the cervical sympathetic nerve of the rat contains both vasoconstrictor and vasodilator fibers to the submaxillary gland and that, under certain conditions, the action of one kind of fiber may dominate over the other.

A cannula was placed in the external jugular vein or its external maxillary branch of a lightly anesthetized cat, and all contributory veins from the submaxillary gland save one, were tied off. The rate of blood flow in drops was recorded on a kymograph. In 8 of 12 animals, electrical stimulation of the cervical sympathetic increased the blood flow to 2-5 times the normal flow by vasodilatation; in the remaining 4, it reduced the flow.

Both the latent period of augmented flow and the augmented flow time varied from animal to animal. In general, the latent period varied from 5 to 10 seconds; the flow time, from 10 to 20 seconds (regardless of continued stimulation). Occasionally, the flow time persisted for a minute or more, sometimes outlasting the stimulation by 10-60 seconds. No correlation was found between blood flow and secretion rate of the gland.

The reactions to stimulation were varied. In a few instances, no change in blood output occurred until the stimulation had ceased; in others, the flow was augmented during stimulation and increased even more upon cessation of stimulation. Occasionally, the stimulation produced a diminution of blood flow, followed by a great increase upon cessation. In general, these variations occurred more frequently with

the stronger intensities of the stimulating current, suggesting the influence of both the dilator and constrictor fibers on the arterioles.

A more or less rhythmical alteration of periods of augmented and retarded flow occurred in some cases when the cervical sympathetic, either in the neck or on the submaxillary artery, was stimulated with strong currents.

Stimuli too weak to cause secretion produced augmented flow; atropine may paralyze the secretory action of the cervical sympathetic before paralysis of the dilator mechanism occurs, to the extent that secretion fails to occur with even the strongest stimulation, although an augmentation of blood flow occurs. It appears, therefore, that the cervical sympathetic of the cat contains vasodilator fibers to the submaxillary gland.

At a certain stage of atropin poisoning, the sympathetic causes pure vaso-constriction in the gland. The different effects of various dosages of atropin are described. In general, atropin has a greater depressor action on the dilator than on the mechanism of the constrictors, accounting for constriction when both vaso-constrictors and vaso-dilators are stimulated, in opposition to the effect in the normal (non-atropinized) cat, where the dilatory action would prevail.

No investigations were made on the vasomotor action of the cervical sympathetic on the parotid and sublingual glands.

Carlson, A. J., and F. C. McLean, 1908. FURTHER STUDIES ON THE RELATION OF THE OXYGEN SUPPLY OF THE SALIVARY GLANDS TO THE COMPOSITION OF THE SALIVA. *Amer. Jour. Physiol.*, 20 (4): 457-469.

In studying the relation of oxygen supply of the salivary glands to the saliva composition, the methods of Carlson, Greer, and Becht (Carlson, 19070) were employed in the greater part of the experimentation.

Saliva composition changes were studied in the dog during stimulation of the chorda tympani. A gradual diminution of organic solids during a single period of stimulation occurred in each of 7 experiments. This diminution was independent, at least partially, of the rate of secretion.

In 10 experiments, intravenous pilocarpine injections were given to two rabbits, seven cats, and one dog; experiments 1 through 4 studied the effect of stimulation of the cervical sympathetic on saliva composition. It was seen that stimulation of the cervical sympathetic during the action of pilocarpine diminished the rate of secretion, increased the percentage of organic solids, and generally decreased the percentage of inorganic solids. This applied to dog, cat, and rabbit. Experiments 6 through 10 produced the same effect by diminution of the oxygen supply to the gland by occlusion of the gland veins or arteries. Results for the parotid and submaxillary glands indicate a probable relationship between the oxygen supply to the gland and the percentage composition of the saliva. This may be true for all salivary glands of mammals.

The effect of previous stimulation of the cervical sympathetic (i. e. previous to stimulation of the cranial secretory nerves) on the composition of chorda submaxillary saliva and pilocarpine parotid saliva was studied in 16

experiments (13 on dog's submaxillary, 1 on dog's parotid, and 2 on rabbit's parotid). In 3 cases, the chorda saliva was slightly richer in organic solids after sympathetic stimulation; in 4 cases, the percentage of organic constituents was altered; and in the remaining 8 experiments, the saliva was poorer in organic solids.

The effect of previous anemia (venous or arterial occlusion) on the composition of chorda saliva was studied in 8 experiments. In each of the first 6 experiments, in which the chorda stimulation was begun immediately on release of the gland blood vessels, the chorda saliva was more concentrated than that obtained previous to the circulatory obstruction of the gland. In 2 experiments, where a lapse of 5-6 minutes occurred between restoration of the normal gland circulation and the beginning of the chorda stimulation, the saliva was either the same as normal or contained less organic solids than normal. From this it is evident that the effect of sympathetic stimulation on the percentage composition of saliva secreted after stimulation of the cranial secretory nerves, may be duplicated by producing partial anemia of the gland by diminution of the oxygen supply by either arterial obstruction or venous occlusion.

Carlson, A. J., and J. G. Ryan, 1908a. THE DIASTASE IN CAT'S SALIVA. *Amer. Jour. Physiol.*, 22 (1): 1-15.

The diastatic power of parotid and submaxillary salivary secretion was studied in many cats (few dogs) under general (ether) or local (ethyl chloride) anesthesia. Animals were fed a mixed diet of bread and meat. Secretion was induced with ether vapors or dilute acetic acid, by pilocarpine, or by chorda and sympathetic stimulation. Saliva was collected from the Wharton and Stenson ducts; in addition, blood samples were obtained. Diastatic power was determined (a) by noting the degree of clearing of boiled starch solution, and (b) by testing for dextrime with iodine.

Pure glandular and mixed saliva was found to contain a diastatic enzyme (ferment) capable of hydrolyzing starch. On the whole, the amount of enzyme in the animal saliva was very small in comparison with that reported for human saliva. No evidence was found to show that the diastatic enzyme is identical with ptyalin. Concentrations of the diastase were observed to be greater in saliva collected under anesthesia than that collected without anesthesia; greater in the submaxillary saliva than in the parotid; greater in sympathetic saliva than in chorda; greater in the blood serum than in the saliva.

It is suggested that the enzyme is not a specific product of the salivary gland, but is carried from the blood into the saliva.

Carlson, A. J., and J. G. Ryan, 1908b. GLUCOSE IN SALIVA. *Amer. Jour. Physiol.*, 21 (3): 301-309.

Submaxillary, sublingual, and parotid salivary secretion of cats was obtained by stimulation with ether vapor or weak acetic acid, by pilocarpine injection, or by chorda tympani and sympathetic stimulation. Glucose was found qualitatively in the saliva by the following tests: safranin, fermentation, reduction with Fehling's solution, and phenylhydrazine. It is concluded

that the glucose in the cat's saliva is not a special product of the salivary glands, but is simply the glucose of blood eliminated by the glands.

Carlson, A. J., and J. G. Ryan, 1908c. GLUCOSE IN SALIVA. *Amer. Jour. Physiol.*, 21 (3): 301-309.

Glucose detection tests performed on the salivary secretions of cats revealed that parotid, submaxillary, and sublingual secretions contain traces of a reducing substance or glucose, probably resulting from the glandular blood supply. A series of tests demonstrated that the sugar content of saliva gradually increases under constant anesthesia and that the salivary glucose following either anesthesia, ether vapor, pilocarpine, or weak acetic acid is greater than that contained in normal reflex secretions.

Submaxillary saliva always appears to contain a higher percentage of glucose than parotid saliva; submaxillary-sympathetic salivary glucose was found to be more abundant than submaxillary-chorda salivary glucose.

The salivary glucose level bears a direct relationship to blood glucose content.

Carlson, A. J., and A. L. Crittenden, 1910. THE RELATION OF PTYALIN CONCENTRATION TO THE DIET AND TO THE RATE OF SALIVARY SECRETION. *Proc. Soc. exper. Biol. Med.*, 7 (2): 52-54.

Observations on the effect of diet on the diastatic activity of the salivas of 3 persons over various periods of time indicated that abnormal diet, even years of exclusion of meats, had no effect on diastatic activity. The diastatic power of parotid or mixed salivas of 7 monkeys was equal to or less than that in man, while that of rabbits' parotid saliva was equal to or greater than that in man. Salivas of 6 goats and 13 horses tested had no diastatic power.

The rate of ptyalin secretion varied directly to the rate of secretion, but the relationship was not a close one. Qualitatively different stimuli produced no significant difference in parotid ptyalin secretion.

Carlson, A. J., and A. L. Chittenden, 1910a. THE RELATION OF PTYALIN CONCENTRATION TO THE DIET AND TO THE RATE OF SECRETION OF THE SALIVA. *Amer. Jour. Physiol.*, 26 (1): 169-177.

The ptyalin concentration of saliva was tested in a series of experiments by the starch method: 0.1 or 0.2 cc. of saliva was mixed with 25 cc. of 1% boiled starch. The rate of clearing of the starch solution, the rate of disappearance of blue starch color on addition of iodine, and the rate of disappearance of erythrodextrin were determined.

The diastatic power of the parotid saliva was studied in 3 human subjects. A cannula was inserted in the opening of Stenson's duct and secretion was stimulated by placing weak acetic acid in the mouth. No difference in diastatic power (ptyalin concentration) could be produced by altering the diet (with and without meat) over a period of 10 days. The same level of ptyalin concentration in the parotid saliva was observed in a middle-aged male vegetarian studied over a period of 7 days. In a 6-day period, the same results were obtained from the

parotid and mixed saliva of a boy (14 years old) who had eaten very little meat. It is concluded that there is no evidence that ptyalin in the parotid or mixed saliva is appreciably increased in man in which meats are excluded from the diet and carbohydrates are greatly increased over a period of years.

Pure parotid saliva was obtained from 5 foxes. Results were the same as those reported in the literature for cat and dog: fox parotid saliva exhibits a weak diastatic action, but very much weaker than blood or lymph.

Parotid and mixed saliva of 7 monkeys of different species and different ages showed that ptyalin in monkeys is the same or less than that in man.

The saliva of 5 goats of different ages was tested. In one goat a temporary fistula in one of the Stenson ducts was made and the saliva collected while the animal was eating; mixed saliva was obtained in the other 4 goats. When 1 cc. of goat saliva (parotid and mixed) was added to 25 cc. of starch and placed in a thermostat at 38°, no appreciable clearing of solution was found in 24 hours.

Tests on the mixed saliva of 12 horses gave the same results.

The significance of the presence or absence of ptyalin in different mammalian groups to their diet habits is discussed.

From a number of determinations on the relation of ptyalin concentration to the rate of secretion of saliva in man, using different strengths of acetic acid or sand and acetic acid as stimuli, it was found that the concentration of ptyalin in saliva increases with the rate of secretion and that saliva that is secreted the fastest exhibits the greatest digestive power.

Qualitatively different oral stimuli (acid, salt, sweet, bitter, mechanical, agreeable, disagreeable) yield no constant difference in the ptyalin concentration of the parotid saliva.

Carlson, Victor R., and M. Linn McKinstry, 1924. SOME STUDIES ON SALIVA, WITH PARTICULAR REFERENCE TO INDUCED ACIDITY AND ALKALINITY. *Dental Cosmos*, 66 (8): 840-849.

Studies were made by titration methods of the acidity and alkalinity of the saliva of a group of college men. Saliva was collected under paraffin oil.

Normal alveolar saliva, collected and tested in this manner, from a group of 127 students, showed an average pH of 6.85, and ranged from 6.66 to 7.02. Muscular activity, such as that of mastication in an attempt to increase saliva flow without the use of other stimulation, brought about a momentary rise in pH.

The effect of food (such as citrus fruit) or the introduction to the oral cavity of various acid or alkaline substances (such as sodium bicarbonate, milk of magnesia, 3% acetic acid, saturated lime water, powdered castile soap, and various acid or alkaline tooth pastes) was also studied. It was found that the pH changed but that it reverted to normal within a period of 15 to 20 minutes, in most cases, regardless of the original strength of the material introduced, showing the quick action of the buffering agents in saliva. Probably the slower return to normal in the case of the use of milk of magnesia was due to the slowly dissolving particles of

magnesium hydrate. In case of prolonged use of an acidic substance, the salivary glands would have to draw on the alkali reserve of the blood for their supply of sodium and potassium.

Carnot, Paul, 1896. SUR UN FERMENT OXYDANT DE LA SALIVE ET DE QUELQUES AUTRES SÉCRÉTIONS [On an oxidizing enzyme of saliva and of some other secretions]. *Compt. rend. de la Soc. de Biol. (Paris)*, 48 (19): 552-555.

The presence of an oxidizing agent in saliva was established in tests making use of tincture of guaiacum, salicylic aldehyde, paraphenylene diamine and hydroquinone. Tests were made in man, the dog, and the horse. Among other body fluids tested, tears were found to have a weaker reaction than saliva.

Carroll, Benjamin, and John W. Van Dyk, 1952. THE ACTIVITY OF α -AMYLASE AS DETERMINED BY ADSORPTION INDICATORS. *Science*, 116 (3007): 168-169.

Dilutions of filtered saliva (600-9000) to provide relative concentrations of salivary α -amylase of 1, 2, 5, and 15 were incubated at 24°C in a solution containing 0.05% Lintner's starch, 3×10^{-5} M Congo Red, plus 0.01 M NaCl and 0.01 μ phosphate buffer at pH 7. Use of a Beckman DU spectrophotometer showed the dye, which undergoes a rapid, reversible, 20% loss of intensity of the spectral minimum at 402 m μ and a 5% peak enhancement on adsorption by the starch, to regain its optical density as hydrolysis gradually lessens the dye-holding power of the starch. Results show a linear relationship between the relative concentration of the salivary α -amylase and the reciprocal of the time required to attain a given optical density. The dye is considered useful in the study of the α -amylases as it does not appreciably inhibit enzyme activity and does show a color response to polysaccharides of a minimal 5 glucose-unit chain.

Carter, William J., W. L. White, and K. Bass, 1953. EFFECTIVENESS OF ORAL AND PERORAL PENICILLIN ON ORAL LACTOBACILLI IN HUMAN BEINGS. *Oral Surg.*, 6 (11): 1289-1300.

The effectiveness of penicillin on oral lactobacilli and other oral bacterial inhabitants was determined in three separate studies: first, to determine the bihourly effect of a troche containing 20,000 units of penicillin and 50 units of bacitracin; second, to show the effect of one and two day treatment on a large number of individuals with troches of various concentrations and compared with a placebo; third, to show the effect of a peroral tablet of penicillin on the oral flora.

This investigation demonstrated that oral lactobacilli are sensitive to the action of penicillin contained in a troche. This effect is transitory and lasts for a period of less than 24 hours. After this time the lactobacilli colonies increased to higher levels in most cases than those previously noted. Other oral bacterial inhabitants such as streptococci and staphylococci were also sensitive to the penicillin troches and required longer periods to regenerate their populations once inhibited. There was no inhibitory effect on lactobacilli demonstrated with the peroral penicillin tablets

at 3 dosage levels. An increase of yeasts and molds in the saliva occurred with the administration of penicillin. It is noted, however, that fewer yeasts appeared in the saliva of patients taking the 5,000 unit troche in which a fungicide was incorporated.

Carter, W. J., H. R. Englander, K. C. Hoerman, I. L. Shklar, and L. Stein, 1955. PHOSPHATASE ACTIVITY IN THE SALIVAS OF CARIES-FREE AND CARIES-ACTIVE INDIVIDUALS. *Jour. Dental Res.*, 34 (5): 677.

Phosphatase activity tests were made on 25 ml. samples of paraffin-stimulated saliva from a group of 100 males, having a average age of 19 years and lacking acute oral infections. The mean acid phosphatase activity of the salivary samples was 0.57 units/100 ml. of saliva; the mean alkaline phosphatase activity was 4.72 units /100 ml. Results of similar determinations of salivary samples from 2 groups of 26 similar individuals, caries-free and caries-active, showed differences in acid and alkaline phosphatase activity to be statistically insignificant. Tests for these salivary enzymes are not considered as a satisfactory index to dental caries activity.

Carter, William J., K. C. Hoerman, H. R. Englander, and I. L. Shklar, 1956. ORAL PHOSPHATASE LEVELS AND CARIES ACTIVITY. *Science*, 123 (3191): 325-326.

Analyses for phosphatase levels were made of whole paraffin-stimulated salivas in a random (acute cases of gingival infection were excluded) group of 100 naval recruits, in a group of 26 caries-free individuals, and in a group of 26 caries-active individuals who had no dental restorations.

Colorimetric tests of 15 ml. samples of whole saliva from each individual showed the mean acid phosphatase activity to be 4.72 units/100 ml. of saliva in the random group, 5.65/100 ml. in the caries-free group, and 7.61 units/100 ml. in the caries-active group. The mean alkaline phosphatase activity was 0.57 units/100 ml. in the salivas of the random group, 0.58/100 ml. in the caries-free group, and 0.68 units/100 ml. in the caries-active group. Statistical analysis of the differences in phosphatase levels did not reveal significance.

Carter, W. J., H. R. Englander, and T. B. Weber, 1958. CHLORIDE LEVELS IN PAROTID SECRETION. *Jour. dent. Res.*, 37 (5): 902-905.

The chloride levels in the parotid salivas of 41 relatively caries-free and 50 caries-rampant males were compared. The mean chloride concentration was significantly greater in the caries-rampant group, but the high frequency of individual overlapping between the two groups ruled out the possibility of using this as a test for caries activity. For a given individual, chloride ion concentration showed a positive correlation with parotid saliva flow rate. The mean parotid flow rates for 5-minute periods of stimulation were the same in individuals with extreme differences in dental caries experience. (Author's summary)

Cary, J. E., 1946. THE DEVELOPMENT OF ALKALI WITH SALIVA AND ITS RELATION TO DENTAL CARIES. *Austral. Jour. Dentistry*, 50 (1): 4-21.

An extensive review of the literature on saliva and its relation to dental caries is presented.

From his own experimental data, the author concludes that: 1) Contrary to Grove and Grove (Dental Cosmos, 76: 1029. 1934), the ammonia content of saliva is not the immunizing factor in dental caries. 2) The ammonia nitrogen content of the saliva of caries-active persons ranges from 1.82 to 6.8 mg./100 cc. with a mean of 4.59 ± 0.53 (micro-Kjeldahl method); from 1.12 to 8.22 with a mean of 3.38 ± 0.62 (Conway method); from 0.28 to 9.56 with a mean of 3.46 ± 0.98 (repetition of Conway method); and from 0.28 to 9.56 with a mean of 3.81 (combining both methods). In the caries-free persons, the ammonia nitrogen content of saliva in mg./100 cc., ranged from 1.82 to 14.0 with a mean of 5.96 ± 1.54 ; from 1.96 to 9.14 with a mean of 4.45 ± 0.56 ; from 1.08 to 6.06, with a mean of 2.76 ± 0.53 ; and 1.08 to 14.0 with a mean of 4.72, respectively, using the methods above. 3) Presence of ammonia is due solely to bacterial action. 4) Salivary ammonia may be slightly influenced by food residues in the mouth; but cannot be affected by food by way of blood circulation (diet). 5) Free ammonia in the mouth may only be an immunizing factor against caries in persons having dirty mouths with little or no oral hygiene, since ammonia formation in clean, comparatively healthy mouths is slight.

Suggestions for caries control are presented (i.e., chewing gum as an aid to oral hygiene or the possible addition of small amounts of urea to the diet).

8 tables of data and 5 graphs are included. 62 refs.

Casassa, M. T., 1937. CONTRIBUTO ALLO STUDIO DEL POTERE BATTERICIDA DELLA SALIVA UMANA. RICERCHE SU SALIVE DI SOGGETTI SANI ED AMMALATI DI DIFTERITE [Contribution to the study of the bactericidal power of human saliva. Studies on the saliva of healthy subjects and of diphtheria patients]. Gior. Batteriol. e Immunol., 18 (3): 381-387.

Bactericidal properties against *Corynebacterium diphtheriae* and *Staphylococcus pyogenes* [*Micrococcus pyogenes*] were found in filtered human saliva. It was present in the salivas of the healthy subjects and of the diphtheria patients, both in fresh saliva and in saliva heated at 56°C for 1/2 hour. These findings indicate that the bactericidal action of the saliva is not due to specific immune bodies.

Case, James T., and W. N. Boldyreff, 1925. A STUDY OF THE INFLUENCE OF HIGH VOLTAGE ROENTGEN IRRADIATION ON SALIVARY SECRETION IN DOGS AND ITS EFFECT ON THE SENSIBILITY OF THE BUCCAL MUCOSA. Amer. Jour. Roentgenol., n.s. 13 (2): 130-139.

Filtered roentgen ray irradiation of the salivary glands of three dogs, having both conditioned and unconditioned salivary reflexes, produced a decrease (4 to 5 times) in the amount of saliva from the parotid, submaxillary, and sublingual salivary glands, as well as a reduction in the sensitivity of the buccal mucosa and the mucosa of the tongue. The minimum decreased rate of salivation is reached in approximately three to four weeks and lasts about one

month. Both resultant effects tend to parallel one another and to return to normal within a period of several months.

Castellani, Aldo, Mackenzie Douglas, P. Redaelli, and G. Amalfitano, 1935. EXAMINATION OF THE SALIVA. Jour. trop. Med. and Hyg., 38 (7): 81-87.

A general review is presented of the literature on the physiological, chemical, and bacteriological properties of saliva, as well as of the salivary glands. The review covers the anatomy and physiology of the salivary glands (including the vascular and nerve supplier), the chemical properties of saliva (including pH, enzymes, lysozyme, buffer capacity, etc.), and the bacterial and cellular contents of saliva.

Cattell, McKeen, 1926. SYMPATHETIC RESPONSES TO REPEATED EPINEPHRIN INJECTIONS. Amer. Jour. Physiol., 76 (1): 217-218.

Among the physiologic responses of pithed cats to successive equal injections of small doses of epinephrin, which were given every 5 to 10 minutes for several hours, a gradual increase in the secretion of saliva was noted. The increase reached an average maximum of 4 times the original secretion in 3 to 5 hours after the initial injection. This response held true in 4 out of 5 pithed cats. One failed to show the increase.

Cattell, McKeen, H. G. Wolff, and Dean Clark, 1934. THE LIBERATION OF ADRENERGIC AND CHOLINERGIC SUBSTANCES IN THE SUBMAXILLARY GLAND. Amer. Jour. Physiol., 109 (2): 375-385.

An analysis of the mechanism of submaxillary secretion and changes in blood flow was conducted in cats anesthetized with Dial-Ciba. The lingual nerve trunk containing the chorda tympani, and the cervical sympathetic nerve were severed and arranged for stimulation. The majority of the sympathetic branches not going to the submaxillary gland were destroyed. In experiments where the opposite salivary gland or the nictitating membrane was used as an indicator of the presence of a chemical agent liberated by the gland, the superior cervical ganglion on that side was excised 4 to 8 days previously.

Experiments conducted to measure the amounts of saliva secreted in response to uniform stimulation showed intravenous injection of physostigmine to augment response to chorda stimulation, and of cocaine to augment response to sympathetic stimulation. Administration of ergotoxin abolished salivary sympathetic effects while atropine abolished salivary effects due to parasympathetic stimulation.

Sympathetic stimulation was found to produce a small, inconstant secretion of the opposite, denervated gland, indicating the elaboration of an adrenin-like substance. Contraction of the sympathetomized nictitating membrane of the opposite side of the cat proved to be a more sensitive indicator for possible adrenergic substances released by the submaxillary gland into the blood stream. Complete absence of response followed blocking the return flow of blood from the gland during the period of stimulation. A study of general and local circulatory effects showed chorda stimulation to increase the blood flow through the submaxillary gland;

sympathetic stimulation decreased the flow during the period of stimulus with a sudden, temporary increase in flow occurring on cessation of the stimulus; a decreased blood flow in the opposite denervated gland was noted. The results indicate the elaboration of a chemical adrenergic agent in the submaxillary gland following sympathetic nerve stimulation, in contrast to the cholinergic agent liberated on stimulation of the parasympathetic fibers (cf. Feldberg and Gaddum, 1934).

Cavett, J. W., 1938. THE DETERMINATION OF ALCOHOL IN BLOOD AND OTHER BODY FLUIDS. *Jour. Lab. clin. Med.*, 23 (5): 543-546.

A method for the determination of alcohol in blood, urine, and saliva is described.

Chamberlin, William B., 1930. XEROSTOMIA. *Jour. Amer. med. Assoc.*, 95 (7): 470-472.

A report is given of 4 cases of xerostomia which occurred in women aged 34 to 56 years; the condition was present for from 4 months to 18 years. A deficiency diet is suggested as a possible etiologic factor.

Champion, A. H. Randell, 1932. THE SALIVA IN RELATION TO DENTAL CARIES AND CALCULUS DEPOSITION. *Brit. dent. Jour.*, 53 (5): 209-223.

A study was made of the effect of various factors on the pH of saliva. Any masticatory movement of the jaws produced a rise in salivary pH, while the type of substance taken into the mouth, whether acid or alkaline, had no influence on the pH of the saliva secreted. The salivary pH was not influenced by the acid-base ratio of the blood, either by increasing or decreasing the CO₂ or by disturbing the ratio by the ingestion of acid or alkali salts. The salivary glands did not act as excretory organs for the elimination of constituents present in plasma.

Champy, C., R. Coujard, and C. Coujard, 1945. SUR L'INNERVATION SYMPATHIQUE DES GLANDES [On the sympathetic innervation of glands]. *Compt. rend. de la Soc. de Biol. (Paris)*, 139 (5-6): 264-265.

The innervation of salivary glands (and of other types of glands) of mammals, was studied by means of the senior author's osmium staining technique which colors the adrenergic system. Interstitial cells charged with adrenaline are shown to be situated near the terminals of the glandular canals. All the glandular nerve fibers seem to pass these cells making a simple contact. The innervation of the glandular cells and the type of nerve fiber terminals varies with the nature of the glandular cell, with the neck of the acinus always richly innervated. On the large-caliber canals the sympathetic terminals appear to regulate the distention of the canals during secretion.

Chappell, Walter F., 1896. REPORT OF THREE CASES OF XEROSTOMIA, OR DRY MOUTH. *New York Med. Jour.*, 63 (9): 277-279.

Resultant clinical manifestations of three cases of xerostomia in women are presented and the prescribed treatments are cited. A test, using tartaric acid-coated blue litmus, which was devised to estimate the amount of moisture in the oral cavity is described.

Chatfield, Paul O., 1941. SALIVATION IN RESPONSE TO LOCALIZED STIMULATION OF THE MEDULLA. *Amer. Jour. Physiol.*, 133 (3): 637-641.

The medulla oblongata of the cat was explored by electrical stimulation in an endeavor to localize the salivary centers of the brain. Such points in the medulla were found to be located mainly in the reticular formation and in the region of the intramedullary course of the glossopharyngeal and facial nerves. At most points both the submaxillary and parotid glands were activated on the stimulated side.

Submaxillary salivation was elicited by stimulation of points located mainly rostral and medial to the middle third of the facial nucleus (the most marked salivation was accompanied by movements of the facial muscles). Parotid salivation was caused by stimulation of points scattered through the reticulum mainly in the regions anterior to the nucleus ambiguus, and medial dorsal and posterior to the facial nucleus (maximal parotid salivation was frequently accompanied by movements of the pharynx and larynx).

Blood pressure changes frequently produced by concomitant stimulation of the vasomotor center had no significant effect on salivation.

Chauchard, A. B., and J. Hurynowicz, 1927. ETUDE QUANTITATIVE DE L'ACTION DE L'ION CALCIUM SUR L'EXCITABILITE DE L'APPAREIL SECRETOIRE, CORDE DU TYMPAN-GLANDE SOUS-MAXILLAIRE [A quantitative study of the effect of the calcium ion on the secretory apparatus, chorda tympani-submaxillary gland]. *Compt. rend. de la Soc. de Biol. (Paris)*, 97 (35): 1618-1620.

The effects of decalcification and recalcification of the blood on the sensitivity of the chorda tympani were studied on chloralosed dogs by observing the salivary response of the submaxillary gland to galvanic stimulation of the chorda.

A decrease in calcium ion concentration produced by an intravenous injection of sodium oxalate (4% solution) resulted in little change in the chronaxy of the chorda tympani. An increase in sodium ions resulted in a notable decrease in chronaxy.

Chauchard, A. B., 1932. VARIATIONS DE L'EXCITABILITE DE LA CORNE DU TYMPAN ET DE LA GLANDE SOUS-MAXILLAIRE CONSECUTIVES A LA STIMULATION DU SYMPATHIQUE [Variation in the excitability of the chorda tympani and of the submaxillary gland following sympathetic stimulation]. *Compt. rend. Soc. Biol. (Paris)*, 110: 267-270.

A report is made of four experiments in the dog to study the chronaxy of the chorda tympani and summation effects on the submaxillary gland of sympathetic stimulus. Results show a temporary diminution in chronaxy, occasionally exceeding 60%, with recovery 1-1/2 hours after repeated excitation of the vagosympathetic. A shortening of summation time was also noted.

Chauchard, A., and B. Chauchard, 1932a. MESURE DES MODIFICATIONS DE L'EXCITABILITE DE L'APPAREIL SECRETOIRE CORDE DU TYMPAN-GLANDE SOUS-MAXILLAIRE, SOUS L'INFLUENCE DE LA PILOCARPINE [Determination of the modifications in excitability of the chorda tympani-submaxillary gland secretory apparatus under the influence of pilocarpine. A comparison with the action

of atropine]. *Compt. rend. Soc. Biol. (Paris)*, 109: 848-850.

In tests of electrical stimulation to the chorda of dogs under chloral-morphine anesthesia, the intravenous injection of 0.02-0.025 mg./kg. of pilocarpine was found to produce no continuous flow of saliva but to increase rheobase, to reduce summation time (from 8 sec. to 3 sec.) and to cause some variation in chronaxy. Injection of 0.04 mg./kg. of atropine was found to decrease but not abolish submaxillary secretion. Chronaxy remained about normal but showed a tendency to diminish. Summation time increased from 8 sec. to 14, 15 or 20 sec. Administration of atropine to a dog, showing a reduced summation time due to the injection of pilocarpine, returned the summation time to normal. The two drugs are considered to have an opposite effect on the excitability of the secretory apparatus.

Chauchard, A., and B. Chauchard, 1935a. ACTION DU PIPERIDINOMETHYLBENZODIOXANE SUR LA DOUBLE INNERVATION DE LA GLANDE SOUS-MAXILLAIRE [The action of piperidinomethylbenzodioxane on the double innervation of the sub-maxillary gland]. *Compt. rend. Soc. Biol. (Paris)*, 118: 1175-1177.

A study was made in the chloralosed dog of the effects of piperidinomethylbenzodioxane (933F) on the submaxillary gland and its sympathetic and parasympathetic innervation. Injections of 933F in excess of 2 mg./kg. stimulated abundant flow of submaxillary saliva. Injection of this dosage produced slight initial increase, followed by a drop of a third to a half of the normal chronaxie of the chorda. The rheobase follows an inverse movement of the same amplitude. On the sympathetic nerve the drug causes an increase in chronaxie to 2 or 3 times its normal value which, according to the animal, either returns to the normal value in 15 to 20 minutes, or the rheobase, which increases with chronaxie, continues to rise to become unmeasurable; the nerve may become temporarily insensible to further stimulation. Administration of adrenaline neither inhibited nor shortened duration of sympathetic blockage but did decrease parasympathetic chronaxie and summation time.

Chauchard, A., and B. Chauchard, 1935. LES EFFETS DES AGENTS SYMPATHOET PARASYMPATHOMIMETIQUES SUR L'EXCITABILITE DE L'INNERVATION SECRETOIRE DE LA GLANDE SOUS-MAXILLAIRE [Effects of sympathomimetic and parasympathomimetic agents on the excitability of the secretory innervation of the submaxillary gland]. *Compt. rend. Soc. Biol. (Paris)*, 118: 318-320.

The chronaxie and summation period of the chorda tympani and vagosympathetic nerves were determined in the dog prior to and subsequent to intravenous injection of adrenaline and of acetylcholine. Administration of 0.025 to 0.05 mg. of adrenaline (maximum dose producing no apparent salivation) showed the chronaxie and summation period of both nerves to vary together, a slight drop in chronaxie accompanying a marked drop in summation period, suggesting that the sympathomimetic agent, adrenaline, acts more on the gland than on the nerve itself. The intravenous injection of acetylcholine ($5 \cdot 10^{-8}$ g./kg.) caused a slight increase in chronaxie accompanied

by a marked drop in summation time. Both drugs, affecting the excitability of the chorda and sympathetic indicated by a diminution in the summation time, act on the glandular element as also do pilocarpine and atropine.

Chauchard, A., B. Chauchard, P. Chauchard, 1935b. VARIATIONS DE L'EXCITABILITE DE LA GLANDE SOUS-MAXILLAIRE ET DE SES NERFS SECRETEURS (CORDE DU TYMPAN ET SYMPATHIQUE) SOUS L'INFLUENCE DE LA NICOTINE [Variations in the excitability of the submaxillary gland and of its secretory nerves (chorda tympani and sympathetic) under the influence of nicotine]. *Compt. rend. Soc. Biol. (Paris)*, 119: 1308-1311.

In a study of the effects of nicotine on the neurosecretory system in the chloralosed dog, a subliminal dose of the drug (1 cc. of a 2% solution in a dog of average weight) was administered intravenously after previously determining the normal chronaxie of the chorda and of the preganglionic fibers of the sympathetic nerve, as well as the excitability of the submaxillary gland itself.

Nicotine causes a brief initial phase of diminished summation time in the gland, with salivation in some cases. This is followed by a period of increased summation time with no spontaneous flow of saliva. The chronaxie of the chorda is half its normal value; this action is more marked and lasting with stronger doses of nicotine; even with weak doses chronaxie is increased to a point where the rheobase cannot be measured; the fibers become insensitive to stimuli almost immediately. Weak doses of nicotine raise slightly or do not affect chronaxie of the post-ganglionic fibers; with stronger doses the rheobase and chronaxie are diminished, the latter approaching that of the chorda. Nicotine thus has a complex effect, acting on the gland and unequally on its secretory nerves.

Chauncey, Howard H., and V. F. Lisanti, 1953. DETERMINATION OF THE ENZYME CONTENT OF WHOLE SALIVA. *Jour. dent. Res.*, 32 (5): 642.

A study was made of paraffin-stimulated whole saliva of 56 persons and the presence of 10 enzymes was established. These enzymes included: acid and alkaline phosphatase, total esterase, cholinesterase, lipase, beta-D-galactosidase, beta-glucuronidase, sulfatase, lysozyme, and hyaluronidase. Cannulated parotid saliva was found to contain acid phosphatase, esterases, cholinesterase, lipase, beta-glucuronidase and lysozyme. The parotid secretion contained 1 to 60 percent of the activity found in whole saliva with the exception of lysozyme which was greater than that of whole saliva. The oral bacteria were found to produce all the enzymes except lysozyme.

Chauncey, Howard H., F. Lionetti, R. A. Winer and V. F. Lisanti, 1954. ENZYMES OF HUMAN SALIVA I. The determination, distribution, and origin of whole saliva enzymes. *Jour. Dental Res.*, 33 (3): 321-334.

The presence, distribution, and origin of 12 enzymes were determined in paraffin-stimulated samples of human saliva, collected from 56 persons on rising and prior to oral cleansing. These enzymes included: acid and alkaline

phosphatases, total esterases, cholinesterase, lipase, B-glucuronidase, B-D-galactosidase, and sulfatase (all determined by colorimetric tests), hyaluronidase (determined by a viscosimetric test and lysozyme (determined by a turbidimetric test). Similar tests of cannulated parotid saliva from a random group of 10 of the 56 persons showed the presence of all these enzymes except alkaline phosphatase, sulfatase, B-D-galactosidase, and hyaluronidase. Lysozyme was found in high concentration, having a mean activity level of 67. units and a range of 25 to 136 units /100 ml. of parotid saliva; comparable results for whole saliva are mean, 10.89, and range, 0.37 to 62.50. In further tests inocula of whole saliva from each of 16 of the subjects were incubated in beef brain-heart infusion broth for 24 hours at 37°C. The broth cultures, tested as before for enzyme activity, showed the presence of all these enzymes, except lysozyme and sulfatase.

Chauncey, H. H., V. M. Johnson, and V. F. Lisanti, 1954. PROTEOLYTIC ENZYMES OF HUMAN SALIVA. Jour. Dental res., 33 (5): 652-653.

A report is made of proteolytic enzyme activity demonstrated in whole saliva at both acid and alkaline pH. An active principle, associated with salivary debris, is considered as probably due to bacteria and other cellular components. The enzymatic liberation of acid-soluble products, measured as tyrosine, was used to determine the rate of degradation of casein substrate at pH 7.4, and of hemoglobin substrate at pH 4.0 and 7.5.

An inactive proteolytic enzyme apparently similar to plasminogen, was found in the supernatant fluid of centrifuged whole saliva; activation occurs on addition of a kinase. The salivary protease hydrolyzes both hemoglobin and fibrin. Activity was measured turbidimetrically using a newly-developed fibrin substrate. The presence of protease activity was demonstrated in parotid saliva, the best results being observed on the euglobin fraction obtained by dialysis and ammonium sulfate precipitation of parotid secretion. Determination was made of the optimum pH and substrate concentration and of the effect of known activators and inhibitors of the whole saliva protease. A comparison was made of the enzyme characteristics of serum plasmin and of the activated salivary protease. (From author's abstract)

Chauncey, Howard H., and V. F. Lisanti, 1955. PAROTID GLAND SECRETIONS: FLOW RATE AND INTERRELATIONSHIP OF SALIVARY COMPONENTS. Jour. Dental Res., 34 (5): 678.

Samples of parotid saliva from healthy individuals, using flavored gum base as a salivation agent, were collected twice daily on 2 successive days. A significant increase in salivary rate of flow was noted between the first and the remaining 3 samples; no significant change in flow rate was found after familiarization with the parotid cap had occurred. Parotid salivation rates ranged from 0.30 to 1.78 ml./minute, with a mean rate of 0.72 ml./minute. Analysis of the data showed a significant positive correlation between the flow rate and pH, a lactic acid, bicarbonate, Na, Ca, and total proteins. A negative correlation was found between the flow rate and the potassium content of

parotid saliva. Interrelationships were noted between the various salivary constituents. (From author's abstract)

Chauncey, H. H., F. Lionetti, and V. F. Lisanti, 1957. ENZYMES OF HUMAN SALIVA. II. Parotid saliva total esterases. Jour. dent. Res., 36 (5): 713-716.

Investigation of the enzymatic hydrolysis of β -naphthylacetate by human parotid saliva indicated a pH optimum of 8.6 for parotid saliva total esterases. The Michaelis-Menten constant was calculated to be $1.45 \times 10^{-3}M$. A linear relationship between saliva volume and amount of substrate hydrolyzed was observed. The energy of activation was 5,900 cal. per mole. Maximum activity occurred at 60°C. The temperature coefficient (Q_{10}) for the interval 35° to 45°C. was 1.38.

Chauncey, H. H., and R. L. Degler, 1958. MECHANISMS GOVERNING THE SECRETION OF ELECTROLYTES IN PAROTID SALIVA. Jour. dent. Res., 37 (1): 29.

Among the constituents and properties of saliva reputed to be influenced by the rate of secretion are sodium, bicarbonate, chloride, pH, and buffer capacity. A previously reported study confirmed the positive relationship between flow rate and the sodium, bicarbonate, and pH values. In addition, a positive correlation was observed between the rate of flow and the calcium titer. However, the potassium titer was observed to be inversely related to the rate of secretion, while phosphorus showed no significant correlation with the secretion rate. An investigation of the physiologic processes which govern the secretion of electrolytes by the parotid gland indicated that the following mechanisms might be responsible for these relationships. (1) The carbon dioxide and water, produced by normal glandular metabolism, are converted into carbonic acid which ionizes into a hydrogen ion and a bicarbonate ion. The hydrogen ions so formed are transferred to the blood or extravascular fluid while sodium ions from the blood are transferred to the acinar cells of the gland. The sodium ions become associated with the bicarbonate ions and are secreted in the saliva. (2) Sodium and chloride ions are secreted by the acinar cells at concentrations isotonic with blood and are withdrawn by a process of reabsorption which is dependent on the rate of secretion. The combination of these processes could account for the changes in buffer capacity, pH, bicarbonate, sodium, and chloride observed with increased secretion rates. (Author's abstract)

Chauncey, H. H., V. F. Lisanti, and R. A. Winer, 1958. HUMAN PAROTID GLAND SECRETION: FLOW RATE AND INTERRELATIONSHIPS OF pH AND INORGANIC COMPONENTS. Proc. Soc. exper. Biol. Med., 97 (3): 539-542.

Tests in 5 subjects of the effects on the role of parotid salivary flow produced by holding a lemon-flavored candy in the mouth, or by chewing either paraffin or flavored chewing gum, show the candy to stimulate highly variable flow rates; fairly consistent flow rates were effected by chewing paraffin or flavored gum, if the gum were renewed at 5-minute intervals, with the gum

having the greater stimulatory effect. No differences were found in flow rate or composition of parotid saliva collected from the right gland in 5 subjects before and after breakfast. Only slight bilateral differences were noted in flow rate, pH, K, Ca, HCO_3 , and P titers in gum-stimulated samples of saliva, simultaneously collected from right and left parotid glands in 3 subjects; bilateral differences were noted in salivary levels of Na and Cl in 2 of the subjects.

Analyses of gum-stimulated salivary samples, collected before and after intramuscular injection of 10 mg. of methacholine in each of 2 subjects, showed marked increases in salivary flow rate, Cl, Na, and Ca levels.

Analyses of gum-stimulated samples of parotid saliva collected twice before breakfast on 2 successive days showed a significantly lower rate of flow during collection of the initial sample than during the latter three samples. Significant positive relationships were found between flow rate and the pH, Na, Ca, and HCO_3 levels but not K, and between the pH and Na, Ca, HCO_3 , and Cl levels; positive relationships between the HCO_3 and the Na and Ca contents, and between Cl and Na are also noted.

Chernigovskii (Tchernigovsky), V. N., 1937. INFLUENCE DES IMPULSIONS CORTICALES SUR L'ACTIVITÉ SECRÉTRICE DES GLANDES SALIVAIRES CHEZ LE CHIEN [Influence of the cortical impulses on the secretory activity of the salivary glands in the dog]. Bull. Biol. Méd. expér. URSS, 4 (7): 44-45.

A continuation to Galperin and Pribytkova's study (n.d.) of the negative and positive conditioned reflex influence on pilocarpine salivary secretion was undertaken to clarify certain details. The positive and negative conditioned food reflexes were worked out in 3 dogs. After hypodermic injection of 2.0 mg. pilocarpine and stabilization of the secretion level, the conditioned stimuli were applied in the usual order, at 5 to 10 min. intervals, without reinforcement. The number of salivary drops was registered every 30 sec. by the electrical drop recorder. A rest period of 2 days was allowed after each experiment. The curves obtained lead to the following conclusions:

The positive conditioned stimulant, whatever its provenance, produces a decrease in the salivary secretion rate, while the negative stimulant has the opposite effect. As a rule, the effect of the negative stimulant is always a little weaker than that of the positive stimulant. The physiological stimulants which are considered to be the strongest by Pavlov's school, have a stronger action in these cases also. The changes observed may take place not only during the stimulation, but up to 2 minutes after it. In one animal these rules, which were very constant in the others, were blurred by spontaneous secretory fluctuations. It is believed that the type of nervous activity plays an important part in these experiments. A failure to reproduce these experiments may be due to a bad selection of experimental animals.

Chernigovskii, V. N., 1938. VLIĀNIE KORY BOL'SHIKH POLUSHARĬ NA VYDELENIE IODA SLIUNNYMI ZHELEZAMI PRI UGASHENĬI USLOVNOGO REFLEKSA [The influence of the cerebral cortex on the secretion

of iodine by the salivary glands after extinction of the conditioned reflex]. Fiziol. Zhur. SSSR, 25 (6): 865-870.

Study was made in one dog of the changes in iodine secretion from the salivary gland during extinction of the conditioned reflex, when the stimulating agent gradually becomes an agent of inhibition. Two hours before the experiment the dog was fed meat-rusk powder with addition of 0.4 to 0.6 gm. potassium iodide. Salivary secretion was stimulated by subcutaneous injections of 8 to 10 mg. pilocarpine; about 30 salivary samples were collected in each experiment and the iodine content was determined in 2 cc. samples by the Fellenberg method. A positive conditioned stimulant, a buzzer sound, was superposed to the pilocarpine secretion without reinforcement. Control experiments were made on the day preceding experimentation; experiments were conducted at no less than 10-day intervals. The iodine content of the saliva is relatively low during the first minutes of secretion when the buzzer acts as a secretory stimulant, then an increase appears apparently as the conditioned reflex is completely extinguished. Comparison of these results with those obtained in simple test of reflex extinction on the day preceding experimentation shows that the curves of extinction of the conditioned reflex and of iodine content in the saliva are essentially parallel. The results confirm Mikhelson's findings that a positive stimulation in the cortex decreases the glandular capacity of secreting iodine, an inhibitory stimulation increases it.

Chernikov, A. M., 1928. O KLASSIFIKATSII RAZDRAZHITELEI SLIUNNYKH ZHELEZ [On the classification of stimulants of the salivary glands]. Zhur. teor. i prakt. Med., Baku, 3 (1-2): 33-52.

The relation between the stimulated surface and the physioco-chemical properties of the stimulant was examined in a continuation of an earlier study (Chernikov, 1926). The stimulant was introduced tubally in 30 seconds into the mouth of a fistulated dog, the mouth then rinsed through the same tube in 30 seconds, and the amount of saliva per minute registered. The intervals between stimulations were 5 to 25 minutes, depending on the cessation of salivation; salivary viscosity, dry residue, organic matter, and ash were determined. The study is divided into experiments with electrolytes, non-electrolytes, and controls.

Tabulated results of tests with electrolytes show alkalis, salts, and weak concentrations of organic and inorganic acids to decrease salivation after repeated stimulation. Stronger concentrations of acids first produce an increase in secretion, followed by a decrease. After repeated stimulation with electrolytes, a secondary fluctuation appears: a sudden rise in the secretion rate after the first drop, followed by another gradual decrease. In the case of strong acid concentrations, there are several sudden waves of decreasing height which are attributed to central nervous influences. The difference in the action of the various electrolytes is shown in the concentration required to effect salivation and can be explained by differences in the ionic composition of the electrolytes. In general the electrolytes in order of decreasing stimulatory action on the salivary glands are strong alkalis and inorganic acids, then the organic acids and salts.

Qualitatively, weak concentrations of all electrolytes elicit from the mucous glands a viscous saliva which is rich in dry residue and organic matter. Strong concentrations elicit a thin saliva, poor in organic matter and comparatively rich in ash. By gradually increasing the concentration, one may obtain all the degrees of viscosity in saliva, from one which cannot pass through the viscosimeter to that of distilled water. The opposite relationship exists for the parotid gland, where weak concentrations of electrolytes elicit only a slight secretion of saliva, poor in organic matter and rich in ash. Strong electrolytes elicit a saliva rich in organic matter, and the percentage of ash either drops or remains unchanged; the viscosity remains the same. In the process of exhaustion, the parotid gland follows the general rule, i.e. after repeated strong stimulation, the organic matter content of the saliva decreases, while the ash content remains almost unchanged; with weak stimulation, however, this is not the case.

A series of tests were made with stimulation of the mucous tissue of the tongue after treatment with increasing concentrations of salts. Neither N/10 NaCl solution, nor N/5 CaCl₂ solution first elicited any salivation; N/20 KOH and N/20 NaCl, which usually elicit a great amount of saliva, produced first no secretion, then a gradually increasing amount. Each of these salivary samples was of different composition and viscosity, beginning with a sample very rich in organic matter, then approaching the type of saliva which is usually elicited by these strong stimulants. Then the weak concentrations, which first produced no salivary response, began to elicit secretion. The same stimulant thus elicited in one day salivary samples of different quality. Such changes are, however, more manifest in the mucous glands; the parotid gland responds more consistently to the type of stimulation, regardless of preceding manipulations of the mucosa. It is noted that the animal stood calmly during administration of N/20 KOH or N/20 HCl, and became agitated at the subsequent introductions of N/10 NaCl or N/5 CaCl₂, which initially had produced no reaction. The reaction is considered to depend entirely on the condition of the mouth mucosa. Apparently, the preliminary treatment with weak salts had strengthened the mucosa so that subsequent strong stimulants did not cause the usual effect; this was followed by a loosening of the mucosa which sensitized it to the weakest stimulants. Thus for electrolytes, the changes in salivary secretion depend on the condition of the mucosa and the physico-chemical factors of the stimulant, the chemical properties of the stimulant exerting primary influence.

Results of tests with non-electrolytic sialogogues suggests that their stimulatory effects depend primarily on their surface action. If glycerin or alcohol, which elicit a large amount of saliva, are applied to the tip of the tongue, the saliva is thin. In general, the larger the stimulated surface, the thinner the saliva. By repeating the test with sand, the same result was obtained. The author suggests that this action is due to the hygroscopic property of these substances.

The control experiments fully confirmed the above results. These findings contradict Bol-dyrev's hypothesis (1907) of the consistency of the unconditioned reflex of the salivary glands, which was confirmed in later works (Fol'bort, 1908, and Hansen, 1908); the unconditioned reflex of the mouth mucosa is susceptible of change.

All salivary stimulants can be divided into two groups, the electrolytes whose action is due to the ions, and the non-electrolytes whose action is conditioned by their physical properties. The classification of the salivary stimulants should be based on the mutual relationship between the properties of the stimulants and the receptive surface. The mechanism and classification of all stimulants of the digestive glands should be reviewed in this light.

Chesley, Leon C., 1934. VALIDITY OF IODINE AND COPPER REDUCTION METHODS FOR AMYLASE. *Proc. Soc. exper. Biol. and Med.*, 31 (9): 1097-1101.

Of the achromic iodine method (Johnson, 1908) and the copper reduction method (Mathews, 1920), only the latter was found, using salivary amylase in the in vitro tests, to be valid for the determination of amylase. The copper method quantitatively measures the saccharogenic power of amylase.

Cheyne, Virgil D., 1939. EFFECTS OF SELECTIVE SALIVARY GLAND EXTIRPATION UPON EXPERIMENTAL DENTAL CARIES IN THE RAT. *Proc. Soc. exper. Biol. Med.*, 42 (2): 587-590.

An increase in the incidence of dental caries occurred in 88 rats when all, or parts of, the salivary glands were removed. Rats with retained mucous saliva, kept on a cariogenic diet, showed the most marked effect and in direct proportion to the quantity of serous saliva removed: removal of both parotid and submaxillary glands constituted complete serous removal, while removal of combinations of glands other than this was considered partial removal of serous secretion.

Cheyne, Virgil D., 1940. INHIBITION OF EXPERIMENTAL DENTAL CARIES BY FLUORINE IN THE ABSENCE OF SALIVA. *Proc. Soc. exper. Biol. Med.*, 43 (1): 58-61.

Seventy-six rats (32 with extirpated salivary glands) were placed on a caries-producing diet; 12 of the treated animals received 3 mg. fluorine in addition to the diets. After 200 days, the animals were sacrificed and the effect of fluorine on the teeth was studied. Caries-incidence was significantly higher in animals having reduced salivation. However, among the desalivated animals, those receiving fluorine showed an 80-85% reduction in caries incidence over the others. In 528 teeth of 44 normal animals, there were 1.6 fractured cusps per animal, 9.1 carious cuspal involvements per animal, 3.5 carious teeth, and 0.8 whole teeth destroyed. In 240 teeth of 20 animals with extirpated glands and no fluorine supplement, the respective values were 0.2, 40.0, 10.5, and 6.7; those for 144 teeth of 12 animals receiving 3 mg. fluorine per day were 4.3, 6.0, 2.3, and 0.3, respectively.

Chillingworth, Felix P., 1922. THE INFLUENCE OF ALKALINE AND ACID TOOTH PASTES UPON THE ACTIVITY OF SALIVARY ENZYME. *Jour. dent. Res.*, 4 (3): 375-377.

Tests conducted using both acid (pH 5.3) and alkaline (pH 8.2) tooth pastes indicated that the action of salivary amylase was inhibited by an acid paste but not by an alkaline paste.

Chittenden, R. H., 1882. INFLUENCE OF PEPTONES AND CERTAIN INORGANIC SALTS ON THE DIASTATIC ACTION OF SALIVA. *Jour. Physiol.*, 3: 327-342.

A study was made of the influence of peptones, in acid, alkaline, or aqueous solution, and of the effect of 3 inorganic salts contained in peptones on the diastatic action of stimulated human mixed saliva on starch and glycogen. Results indicated that the peptones stimulated increased activity, particularly in the presence of weak acid, which of itself completely prevents the conversion of starch into sugar. The salts, sodium chloride, sodium phosphate, and calcium phosphate, were found to have no effect on the diastatic activity.

Chittenden, R. H., 1898. VARIATIONS IN THE AMYLOLYTIC POWER OF SALIVA AND THEIR RELATION TO THE CHEMICAL COMPOSITION OF THE SECRETION. *Amer. Jour. Physiol.*, 1 (Proc. sect.): iii-v.

A preliminary paper is given which contains a discussion of the acidity, alkalinity, and amylolytic power of saliva, as well as several factors which influence the amount of amylolytic enzyme in salivary secretions.

Chittenden, R. H., and A. N. Richards, 1898a. VARIATIONS IN THE AMYLOLYTIC POWER AND CHEMICAL COMPOSITION OF HUMAN MIXED SALIVA. *Amer. Jour. Physiol.*, 1 (4): 461-476.

Salivary flow was produced in human subjects by mechanical (chewing a small piece of rubber) or chemical (ether, alcohol, whiskey, gin) stimulation. Determinations of alkalinity (titration with sulfuric acid), total solids, total organic matter, and total inorganic salts were made. Amylolytic power was determined by the amount of maltose formed by the action of saliva on arrow-root starch at 30°C for 1/2 hour.

In the first experiment, the mechanically-stimulated saliva was collected 1/2 hour before and 15 minutes after eating. Salivary alkalinity was usually greater in saliva collected before breakfast than after; this difference was less marked before and after dinner (1:00 P.M.). The alkalinity of the saliva is due to hydrogen alkali phosphates, with possibly some alkali bicarbonate; saliva normally contains no sodium carbonate.

Saliva secreted after a period of glandular inactivity possesses greater amylolytic power than saliva obtained after eating, corresponding to the difference in the proportion of alkaline-salts. Samples obtained every hour or two throughout the twenty-four hours indicated that saliva varies both in composition and in amylolytic power independently of food intake. Chemically-stimulated saliva is thick and viscid, and contains a much larger proportion of mucin than the secretion secured without stimulation.

Chittenden, R. H., L. B. Mendel, and H. C. Jackson, 1898b. A FURTHER STUDY OF THE INFLUENCE OF ALCOHOL AND ALCOHOLIC DRINKS UPON DIGESTION, WITH SPECIAL REFERENCE IN SECRETION. *Amer. Jour. Physiol.*, 1 (2): 164-209.

Analyses were made of human mixed saliva and of canine submaxillary saliva after brief oral exposure to alcoholic fluids. These fluids produced a sudden, brief increase in salivation, as well as an increase in both organic and inorganic constituents of the saliva. The effect produced is common to many stimulants, as dilute acid (vinegar), ether vapor, etc., and is not specific for alcohol. Alcoholic fluids introduced directly into the stomach of dogs produced no appreciable effect on the salivary composition, or rate of secretion, of either the sublingual or the submaxillary gland, induced to minimal flow by continuous faradic stimulation of the chorda. Data are given on gastric secretion and digestion.

Christiaens, L., Sevin, and Mlle. Cornillot, 1946. ELEVATION DES ISO-AGGLUTININES β SÉRIQUES PAR INJECTION DE SALIVE D'INDIVIDUS β SECRETÉURS [Increase of β iso-agglutinins in the serum by injection of saliva of β -secreting individuals]. *Compt. rend. de la Soc. de Biol. (Paris)*, 140 (15-16): 519-521.

Fresh saliva of 2 persons of blood type B, verified as secretory was autoclaved at 120° and then centrifuged. The supernatant fluid was diluted to 1/3 with physiological saline and divided into 1 cc. ampules which were again autoclaved. Eleven type-A persons received subcutaneous injections of 1 cc. of this preparation. A determination of agglutinins 12 days later compared to values determined prior to injection showed a considerable increase of antibodies in 10 of the 11.

Choupe, H., 1888. INFLUENCE DE LA SALIVE HUMAINE SUR LA VÉGÉTATION ET SUR LA GERMINATION [Influence of human saliva on vegetation and on germination]. *Compt. rend. de la Soc. de Biol. (Paris)*, 40 (33): 719.

Soil saturated with saliva suppressed germination of some seeds (morning glory, nasturtium, sweet pea, hemp, flax), while others (wheat, barley, oats) did germinate and grew more rapidly than normal but wilted shortly afterward and died.

Chrzaszcz, T., and Z. Schechtlowna, 1930. DIE AMYLASE DES SPEICHEL DER RINDER UND PFERDE [The salivary amylase of bovine cattle and horses]. *Biochem. Zeitschr.*, 219 (1-3): 30-50.

"1. The amount of saliva secreted by the animal [bovine cattle or horse], is dependent upon the time of day, the meal time, and on the digestion. The minimum amount is produced during the resting period (particularly at night rest); the maximum, during meal time, being more abundant upon a dry diet. From our calculations, an average cow can produce up to 28 liters of saliva within 24 hours, although individual variations are great.

"When on green feed, the saliva is more fluid and is poorer in solid matter.

"2. Bovine saliva is alkaline in reaction and its hydrogen ion concentration, except during rumination, effects a pH of 8.55 to 8.90, averaging 8.80. During rumination (while under influence of gastric juices), the saliva is less alkaline, averaging pH 8.00, dropping even to 7.90.

"Equine saliva is less alkaline, its pH ranging from 8.50 to 8.60.

"3. Bovine and equine saliva contain amylase, which was determined by two methods, i.e., the alcohol and adsorption methods.

"4. The optimum pH for bovine salivary amylase is between 6.5 and 6.6, for equine saliva at 6.2; in both cases employing phosphate buffers and optimum temperature.

"5. The optimum temperature for salivary amylase in cattle at optimum pH is between 45°C. and 40°C.; in the equine saliva the optimum temperature is between 50°C. and 45°C.

"6. The diastatic action of equine saliva is two to four times as powerful as that of the bovine saliva.

"7. The minimum amylase content of saliva is found during rest period and in the morning; the maximum, immediately after the noon meal and during the following hours.

"The mode of feeding has no effect on the amylase content of saliva.

"8. Age, sex, and slight illness have no effect upon the salivary amylase of animals. On the other hand, we find a marked decrease in diastatic action in animals seriously ill.

"9. Sodium chloride [content of saliva] has a propitious effect upon salivary amylase, its optimum amount being 1.5‰. On the other hand, the reduction of chlorides is unfavorable for the diastatic action of saliva.

"10. A favorable influence upon amylase activity of saliva is caused by yeast complement, as well as blood serum.

"11. Saliva which had been stored at 20-25°C., produces a stronger diastatic action, the source of which lies in bacterial development and is not, as has been presumed previously, to be found in a pro-enzymatic form of amylase." (Author's summary, translation.)

Chrzaszcz, Tadeusz, and Jozef Janicki, 1934. THE INACTIVATION OF ANIMAL AMYLASE BY PLANT PARALYSERS AND THE PRESENCE OF INACTIVATING SUBSTANCES IN SOLUTIONS OF ANIMAL AMYLASE. Bio-chem. Jour., 28 (1): 296-304.

A study was made of the in vitro effects of plant paralyzer (sistoamylase), obtained from buckwheat-malt, and eleutoamylase (peptone siccum sine sale) on human salivary and Merck's pancreatic amylase. The resultant amylase liquefying, dextrinizing, and saccharifying powers were used as measure of the treatment effects.

Sistoamylase (0.3 gm.) was found to inactivate 40 ml. of a 5% saliva solution in 8 minutes. Dried sistoamylase, obtained shortly before the experiment, displayed a greater inactivating effect on the animal amylase than did that which secured a year before. Dried sistoamylase was also found to be a more powerful inactivator of amylolytic activity than the undried.

In vitro experiments, in which eleutoamylase (peptone) was added simultaneously with the sistoamylase, revealed that peptone greatly increases the digestive power of salivary amylase. However, although some forms of the paralyzer do not inactivate salivary amylase in the presence of peptone, certain dried forms of the sistoamylase have absorbing abilities of such magnitudes that the amylase-amylolytic powers are not detectible upon the addition of eleutoamylase after the enzyme has been previously inactivated by the paralyzer.

It is suggested, by the authors, that natural amylase-inactivating substances are present in animal amylase, and, therefore, only a portion of the amylase is normally capable of reaction.

Citron, Sherman Ross, 1945. THE ROLE OF ACTINOMYCES ISRAELI IN SALIVARY CALCULUS FORMATION. Jour. dental Res., 24 (2): 87-91.

"A. [Actinomyces] israeli, as indicated by study of 6 strains, was unable to decompose protein material into such simpler compounds as indole or H₂S; also was not able to raise the alkalinity of media or precipitate calcium from an inorganic calcium chloride solution that did not contain phosphate ions.

"A. israeli, as indicated by study of 6 strains, contains alkaline phosphatase and, therefore, may cause precipitation of calcium phosphates from the saliva and initiate calculus formation." (Author's summary.)

Clapper, William E., and Mary E. Heatherman, 1949. STRAIN DIFFERENCES IN ORAL LACTOBACILLI AND THE RELATION TO DENTAL CARIES. Jour. Bacteriol., 58 (2): 261-268.

"The presence of dental caries has been found to be associated with a relatively high incidence of a specific type of Lactobacillus in the saliva and in dental plaques. This type of Lactobacillus produces a pH of less than 5 on glucose broth, has an active dehydrogenase for glucose, ferments salicin, mannitol, rhamnose but not raffinose, and grows rapidly in broth." (Author's summary.)

Clapper, William E., R. A. Downs, and M. E. Heatherman, 1953. THE RELATION OF CARIES ACTIVITY TO LACTOBACILLUS COUNTS AND TYPES AND TO THE FLUORIDE CONTENT OF DRINKING WATER. Jour. dent. Res., 32 (1): 27-34.

Dental and salivary examinations were made of 383 school children, aged 11 to 14 years. One hundred ninety-seven of the children lived in Denver, Colorado, a community having 1 part per million fluoride in the drinking water and 186 children lived in Boulder, Colorado which had no fluoride in the water. Examination the following year showed the Denver children to have 37.1 percent new lesions; the Boulder children had 80.0 percent new lesions. The lactobacilli were classified into fermentative types. The presence of 1 part per million of fluoride in the water bore little relation to the types of lactobacilli found in the saliva of the children. However, the incidence of caries was higher in children having Type I lactobacilli in their saliva than in those having other types and also in children having high lactobacilli counts. Children having no fluoride in the water had a greater number of carious surfaces in the group with low lactobacilli counts when Type I was present. These

values were less high for children with high counts when Type I was present. The group having fluoride showed a slightly higher number of carious surfaces only in the group with high lactobacilli counts when Type I was present.

Clark, Guy W., and G. S. Shell, 1923. THE INORGANIC CONSTITUENTS OF HUMAN SALIVA. *Proc. Soc. exper. Biol. Med.*, 20 (8): 499-500.

Salivary samples from 6 healthy adults, on a fixed diet for 8 weeks, were analyzed for organic and inorganic constituents. Findings (per 100 cc. of saliva) are as follows: total solids averaged 0.706 gm. (range, 0.537-0.923); ash, 0.219 gm. (range, 0.189-0.257); chlorine, 58.0 mg. (40.0-66.0); phosphorus, 11.6 mg. (8.4-15.3); nitrogen as ammonia, 10 mg. (6.0-14.8); nitrogen, 64.9 mg. (52.4-90.0); CO₂ bound as bicarbonate, 11.7 cc. (5.9-15.2). Calcium values, available for only 3 individuals, averaged 6.9, 5.6, and 5.6 mg./100 cc.

Clark, Guy W., and Lena Levine, 1926. CHANGES IN THE REACTION OF RESTING SALIVA PRODUCED BY DIFFERENT MICRO-ORGANISMS. *Proc. Soc. exper. Biol. Med.*, 24 (2): 138-141.

The effects on resting saliva of various organisms and various types of food residues were studied.

Saliva from 3 or 4 adults was pooled. A small portion was removed for controls; the main part, sterilized. The sterilized portion was then inoculated with organisms aspirated from gingival tissue, such as *Streptococcus salivarius*, *S. mitis*, *Staphylococcus albus* var. a., [*Micrococcus pyogenes*], and *Bacillus acidophilus* [*Lactobacillus a.*], and both samples and controls were incubated at 37.5° C. pH determinations, made colorimetrically at various times, showed that in no case the pH was lowered below 5.0. This number was reached only in saliva containing *B. acidophilus* or in the controls containing mixed organisms.

The author concludes that saliva does not attain, by the action of mouth bacteria, a hydrogen-ion concentration sufficiently high to affect the tooth substance.

Clark, Guy W., and Kenneth L. Carter, 1927. FACTORS INVOLVED IN THE REACTION CHANGES OF HUMAN SALIVA. *Jour. biol. Chem.*, 73 (2): 391-404.

"1. The saliva obtained by direct cannulation of the human parotid and sublingual glands is but slightly more acid, 0.1 pH, than freshly expectorated resting saliva.

"2. Although the volume percent of carbon dioxide is much higher in paraffin-activated saliva, it varies in much the same manner as in resting saliva.

"3. Samples of either resting or paraffin-activated saliva may stand for several hours without showing appreciable changes in the carbon dioxide content. This is explained by an equilibrium between the carbon dioxide escaping and that being formed.

"4. The formation of carbon dioxide is probably the result of enzymatic action.

"5. There is apparently some ammonia formed by bacterial action. It is thought, however, that most of it is the result of enzymatic action.

"6. There is no demonstrable relationship between the pH, the volume per cent of carbon dioxide, and the ammonia content. The pH changes

in saliva apparently involve other constituents than those studied. To complete this aspect of the work properly it will be necessary to make complete analyses of a large number of samples of saliva." (Authors' summary.)

Data on pH, CO₂, and ammonia contents under various conditions are presented in Tables 1 to 6 and Figures 2 to 4.

Clark, Guy W., and Lena Levine, 1927a. INORGANIC CONSTITUENTS OF HUMAN SALIVA. II. *Amer. Jour. Physiol.*, 81 (2): 264-275.

Resting and paraffin-activated saliva samples, obtained from human subjects, were analyzed for ash and phosphorus, calcium, and chlorine contents. From the experimental evidence, the authors state that:

"1. The inorganic constituents of paraffin activated saliva show greater quantitative variations than those of resting saliva.

"2. Removal of desquamated cells, food particles, etc., by centrifuging results in a loss of both calcium and phosphorus. It is suggested that these elements are removed in the form of a Ca-P-mucin complex rather than as Ca₃(PO₄)₂ or CaHPO₄.

"3. It is not possible to appreciably change the composition of the saliva by short fasting.

"4. It is difficult to increase the chlorid content of resting saliva by oral ingestion of large amounts of soluble chlorids.

"5. With respect to abnormal ingestion of inorganic phosphorus the salivary glands exhibit a marked excretory function.

"6. Variations of the several constituents of the saliva may be the result of physiological rhythm.

"In conclusion it may be said that each individual reacts differently to stimulation and the individual response to the same type of stimulation varies from time to time with the result that the normal variations in the content of the respective inorganic constituents are sufficiently large to disguise any relationship that may exist." (From the authors' summary.)

Clark, Guy W., John S. Shell, J. Bernard Josephson, and Mary E. Stockle, 1927b. THE INFLUENCE OF DIET UPON THE INORGANIC CONSTITUENTS OF HUMAN SALIVA. *Dental Cosmos*, 69 (5): 500-513; (6): 605-617.

Five prison inmates of varying age, temperament, and nutritional state, but all in satisfactory physical condition, were kept on various diets over a period of 28 weeks.

"It has not been possible to demonstrate the existence of relationships between the amount of a given element ingested or retained and the amount appearing in the circulating blood or in the resting saliva.

"Although the constituents appearing in the saliva must primarily be supplied by the circulating blood (and lymph), it has not been possible to show any relationship between the concentration of the inorganic constituents of the blood and the amount appearing in the saliva:

"The saliva contains relatively large amounts of inorganic phosphorus, from three to five times as much as is found in blood plasma. This inorganic phosphorus is important because it provides the saliva with an excellent buffering system." (From the authors' summary, p. 616.)

Analyses of foods, blood and saliva constituents (calcium, phosphorus, chlorine and chlorides, sodium, potassium, carbon dioxide, sulfur, total nitrogen and ammonia nitrogen, total solids, and organic matter) are given in 13 tables and 11 charts.

Claycomb, C. K., M. M. McChesney, and M. L. Snyder, 1954. A RAPID QUANTITATIVE LABORATORY TEST FOR SALIVARY AMYLASE. *Jour. Dental Res.*, 33 (5): 654.

A report is made of a photometric method based on the intensity of blue color from the iodine-starch reaction in the presence and absence of amylase. Alpha-amylase was used to determine optimum starch, iodine, incubation time and temperature to provide a linear response; after determination of test variables, reproducible results were obtained with serial dilutions of either commercial amylase or saliva. In tests, 0.5 ml. of saliva was incubated at 40°C with 250 mg. of starch in a phosphate buffer at pH 7.0 for 5 minutes, at which time enzymatic activity was arrested and color developed by addition of HCl-I mixture. The percentage of light transmission obtained was taken as an index of amylase activity bases on prior standardized studies. In 421 tests, 86% permitted 0-40% light transmission; 64% of this group permitted 10-20% transmission. Inherent instrument error apparently is insignificant. No correlation was found between increasing levels of salivary amylase activity and increasing numbers of lactobacilli, or of positive Snyder tests in respective specimens of saliva. (From author's abstract)

Claycomb, C. K., M. N. McChesney, and M. L. Snyder, 1956. A SIMPLE RAPID METHOD FOR QUANTITATIVE DETERMINATION OF SALIVARY AMYLASE. *Jour. dent. Res.*, 35 (3): 391-398.

The starch remaining, after 19 ml. of a 1.28 percent solution of starch is incubated for 5 minutes with 0.1 ml. of saliva, is determined photocolormetrically by development of the starch-iodine blue complex. The amount of human salivary α -amylase present is determined by comparison with activity of known amounts of commercial amylase under the same experimental conditions. All reagents used in the technic, except for the HCl-KI₃ working solution, can be prepared at least 24 hours previously; two technicians can analyze 150 samples of saliva per day. Analysis of 1228 specimens of saliva showed 55 percent of specimens to have less than 1.5 mg. of α -amylase/ml. saliva, and 5 percent to have more than 5.0 mg./ml. No relationship was found between the α -amylase content and the lactobacillus count, acid production, or volume of the respective specimens of saliva.

Clegg, C. T., and J. J. Rae, 1955. AMMONIA PRODUCTION IN SALIVA. *Jour. Dental Res.*, 34 (5): 679.

The production of ammonia by incubated saliva can be inhibited by addition of glucose in the saliva in concentrations down to 0.1%. Buffering of the saliva at pH 7.0 does not block the glucose inhibition, indicating that the glucose inhibition is not entirely due to a lowering of the pH.

An active urease in saliva produces large amounts of ammonia in addition of low concentrations (0.1%) of urea to the saliva; addition of a large amount of urea (10%) inhibits ammonia production. Addition of glucose to a saliva-urea

mixture alone. Buffering the saliva-urea-glucose mixtures at pH 7.0 inhibits the stimulating effect of the glucose which indicates the stimulation to be possibly due to a pH effect. (From author's abstract.)

Clegg, C. T., and J. J. Rae, 1956. AMMONIA PRODUCTION IN SALIVA II. *Jour. dental Res.*, 35 (3): 438-439.

Various concentrations of glucose and urea were added separately or in combination to saliva. Addition of glucose alone showed small amounts (0.1%) to result in large drops in pH on incubation of the saliva. Wide variation in the final glucose concentration, 0.1 to 10%, produced comparable drops in pH indicating no apparent relation between the concentration and pH drop. Addition of urea alone prior to incubation showed concentrations below 0.3% to cause no pH rise while concentrations up to 5.0% caused the pH to rise from 7.0 to 9.0. Addition to saliva of urea concentrations varying from 0.1 to 5.0% produced comparable amounts of ammonia; 10% urea inhibited ammonia production. Tests of varying the glucose/urea ratio, when both substances were added to saliva, showed a 1:1 ratio to permit optimum ammonia production; a 1:0.1 ratio or lower did not prevent a pH drop although ammonia production remained high; raising the urea level above 1:3 inhibited ammonia production. [Cf. Ballantyne, 1951]

Clement, A. L., R. Plotkin, and L. S. Fosdick, 1956. THE FORMATION OF LACTIC ACID IN DENTAL PLAQUES. II. ORAL CONDITIONS OF PRIMITIVE BUSHMEN OF THE WESTERN KALAHARI DESERT. *Jour. Dental Res.*, 35 (5): 786-791.

An examination of oral conditions in 50 Bushmen showed the group to be caries-inactive; oral hygiene to be poor, calculus formation marked, and periodontal disease rampant. The buffering capacity and flow of paraffin-stimulated saliva, measured in 27 subjects, were found about the same as that in white caries-active cases.

Clifford, Winifred M., 1925. THE EFFECT OF HALOGEN SALTS ON SALIVARY DIGESTION. *Biochem. Jour.*, 19 (2): 218-220.

The effects of various halogen salts on the salivary digestion time of starch are noted and compared. In vitro tests showed NaCl, KCl, NH₄Cl, and CaCl₂ to decrease the digestion time, while KF, NH₄I, and CaI₂ slowed the salivary action and thus, increased the reaction time; NaI, KI, NaF, and bromides had no effect on the enzymatic processes.

The effects of the hydrogen ion concentration upon the digestion time of starch by saliva, in the presence of halogen salts, are also tabulated.

Clifford, Winifred M., 1936. EFFECT OF HALOGEN SALTS ON SALIVARY AND PANCREATIC AMYLASE. *Biochem. Jour.*, 30 (11): 2049-2053.

A continuation of a previous study (Clifford, 1925) is made in which the effects of variations of the concentrations of halogens on the salivary digestive ability on starch are noted. Findings reveal that Li, Na, K, NH₄, Mg, Ca, and Ba salts of chlorides, bromides, and iodides decrease the digestion time of salivary and pancreatic amylases on starch by quickening the reaction processes. The most potent hastening effects over the widest concentration is exhibited by chloride salts, the potency of which is followed in descending

acceleration power by the bromides, the iodides, and the fluorides. Na, K, and NH_4 fluorides, and Li, NH_4 , Mg, and Ca iodides at high concentrations were found to inhibit the amylolytic processes.

It is concluded that, depending upon their salt concentrations, all of the halogens (except) fluorides accelerate the digestive processes of salivary and pancreatic amylase on starch.

Clough, O. W., 1933. EFFECTS OF SALIVA ON GROWTH OF BACTERIUM COLI. Jour. dental Res., 13 (3): 183-184.

The effects of addition of salivary filtrate to culture media upon the growth of Bacterium coli [Escherichia coli] were tested; sterile tap water replaced the salivary filtrate in the controls. Equal inocula of the bacterium were introduced into test and control tubes and the number of organisms in each tube was estimated at intervals by a hemocytometer. In 16 experiments, fewer cells developed in saliva-filtrate media than in tap water tubes. Additional tests were set up using salivary filtrate heated for 1 hour at 68°C : fewer organisms were found in media containing unheated saliva than in those with saliva that had been heated. Unheated saliva media indicated a possible inhibitory effect on staphylococci (but not on pneumococci). No such influence was exhibited by heated saliva filtrate.

Clough, O. W., 1934. INHIBITION OF BACTERIAL GROWTH BY HUMAN SALIVA. Jour. dental Res., 14 (3): 164.

"Inhibiting effects on bacterial growth were studied by placing filtered and unfiltered salivas in separate wells in agar plates heavily streaked with a test organism. Douglas broth in another well in the same plate was used as a control. The organisms were Staph. albus, Bact. dysenteriae, Shiga, B. subtilis, Proteus vulgaris, Sarcina lutea, Bact. coli, M. lysodeikticus, Bact. typhosus, and B. megatherium. Salivas from ten people were tested on one or more different days. A zone of inhibition, 4 mm. or wider, invariably occurred around the wells containing fresh unfiltered saliva in plates inoculated with B. megatherium and S. lutea. Degrees of inhibition of B. subtilis, P. vulgaris, B. dysenteriae, B. coli, M. lysodeikticus, and S. albus, diminished in the order listed. The first four showed a zone more than 2.5 mm. wide; the last two, 0.5 mm. or less. The same individuals salivas gave similar results when tested on different days. Filtered saliva, excepting a few samples, showed no inhibitory effect. Of forty-one different salivas tested against Lactobac. acidophilus, using wells in poured plates of Kulp's tomato-juice agar, all but one inhibited growth, the zone of inhibition varying from 0.5 mm. to 6 or 8 mm. Filtered saliva showed no inhibitory effect."

Clough, O. W., 1935. INHIBITORY EFFECT OF SALIVA ON LACTOBACILLUS ACIDOPHILUS. Jour. dental Res., 15 (3-4): 213.

Saliva samples and control fluids were placed in wells cut into agar plates inoculated with Lactobacillus acidophilus; the plates were incubated for 48 hours at 37°C . and the inhibitory effects of saliva were observed.

One hundred and thirty-one of 133 saliva samples from 77 apparently healthy individuals inhibited bacterial growth. 8 of 77 samples obtained

from children 6 to 16 years of age, showed no inhibition of L. acidophilus; no correlation could be seen between the inhibition of L. acidophilus and the extent of dental caries.

When the saliva was centrifuged, the inhibitory action was found in the supernatant fluid. When the supernatant fluid was filtered through a Berkefeld candle, the inhibitory properties were lacking in the first 10-12 cc. of filtrate; subsequent portions were inhibitory.

The inhibitory agent was destroyed by heating at 75°C . for 5 minutes.

Clough, Oliver W., Basil G. Bibby, and George P. Berry, 1938. THE EFFECT OF SALIVA ON LACTOBACILLUS ACIDOPHILUS. Jour. dental Res., 17 (6): 493-498.

The salivas of 204 individuals were tested for inhibitory effect upon Lactobacillus acidophilus.

Wells were cut into tomato-agar plate cultures of the bacterium and were filled with saliva or control fluids (0.85 sodium chloride solution or distilled water). The plates were examined after 48 hours incubation; inhibition was demonstrated by clear, colony-free zones surrounding the wells.

Some growth inhibition occurred in 250 of 260 tests. The control fluids exerted no inhibitory effect.

No correlation could be established between the extent of caries in the mouths of the subjects and the degree of inhibition (measured in mm. of clear zone) occurring around the wells.

Agar plates inoculated with agar removed from inhibition (colony-free) zones of previous cultures failed to develop colonies. Thus, the action of the inhibitory agent was shown to be bactericidal.

0.04 cc. of bacterial suspension containing approximately 2,500 million organisms/cc. were mixed with saline dilutions of saliva (titers from 1:2 to 1:280). No lysis occurred.

A study of the nature of the inhibitory agent showed evidence that it was an inherent component of saliva. Inhibition zones appeared when saliva free from salivary epithelial cells, corpuscles, and bacteria was used. The agent resembled lysozyme (Fleming's) in as much as it was adsorbed during filtration and was inactivated by heating at 75°C . for 5 minutes. Inactivation also occurred by exposure to ultraviolet radiation and after four freezings of the plates.

Coats, D. A., D. A. Denton, and R. D. Wright, 1958. THE IONIC BALANCES AND TRANSFERENCES OF THE SHEEP'S PAROTID GLAND DURING MAXIMAL STIMULATIONS. Jour. Physiol. (London), 144 (1): 108-122.

Simultaneous estimation was made in the denervated parotid gland of 7 Merino sheep concerning arterial inflow and salivary and venous outflow of electrolytes during basal (unstimulated) secretion, and during the parasympathetically-stimulated secretory states of peak flow (Phase I) and equilibrium (Phase II). Saliva and venous blood samples were taken for the consecutive 10, 10, 20, 40, and 40 second periods of continuous maximal stimulation applied at 5-minute intervals; analyses were made of portions of the total sample collected during each period; arterial inflow was calculated as the sum of salivary and venous outflows. Analyses were also made of occasional 2-minute samples and, in 3 experiments, of samples collected up to 42 minutes after start of stimulation. Results show the maximal stimulation to

evoke a 5.80 ± 1.09 ml./minute flow of saliva which gradually dropped to a steady flow of 2.76 ± 0.98 ml./minute after 2 minutes of continuous stimulation. Arterial inflow was usually 10 times the salivary flow about 80 seconds after start of the continuous maximal stimulation, and about 14 times the salivary flow after 2 minutes of this stimulation. Concurrent arterial infusion of bradykinin increased the arterial inflow but produced no change in the salivary flow rate or composition. Salivary concentrations of sodium, potassium, chloride, bicarbonate, and phosphate showed the same phase changes as previously reported (Coats, D. A., 1957). Tabulated results show the ionic concentration (m Eq/L.) of salivary Na^+ to be 190 during peak flow and 182 during stabilized flow; K^+ was 14.3 during peak flow and 9.8 during stabilized flow; Cl^- was 25 during peak flow and 22 during stabilized flow. Glandular aspects of the rapid or "explosive" release of Na and other ionic salivary constituents are discussed in detail.

Cobe, Herbert M., and A. K. Leberknight, 1951. THE USE OF QUATERNARY AMMONIUM COMPOUNDS IN DENTIFRICES. *Jour. dent. Res.*, 30 (4): 558-564.

A discussion is presented on the properties of quaternary ammonium preparations, and the compatibilities and incompatibilities of these compounds having an influence on their use in dentifrices. Bacteriological testing of the compounds showed them to be inhibitive to the general oral flora, but not to the lactobacillus group in particular. It is suggested that this is due to organic material in saliva and the presence of other secretions in the mouth.

Cohen, A. H., 1957. A COMPARISON OF THE SNYDER COLORIMETRIC TEST WITH THE LACTOBACILLUS COUNT USING ROGOSA MEDIUM. *Jour. dent. Res.*, 36 (3): 375-381.

Three separate samples of whole paraffin-stimulated saliva from each of 1049 naval recruits were collected at one week intervals at 11 A.M., after 5 hours of fasting from food, liquids and smoking, for comparative tests of dental caries activity by means of the lactobacillus count and the Snyder test. Findings of the Snyder test, used to measure the time required for a complete change to yellow color, closely paralleled findings of the lactobacillus counts using Rogosa medium, both showing a high correlation to dental caries experience as indicated by DMF teeth. The highest relationships between the two tests appeared at the DMF classification extremes of 0 and +4.

Cohn, Essie White, and Margaret Hessler Brookes, 1936. THE DIASTATIC ACTIVITY OF RAT SALIVA. *Jour. biol. Chem.*, 114 (1): 139-145.

A quantitative determination was made of the diastatic activity of rat saliva.

Rat saliva, stimulated by chewing on a sponge for 1 to 5 minutes, was collected and placed in tubes containing 10 cc. of 2% starch solution, 4 cc. of phosphate buffer of pH 6.8, 4 cc. of 0.5% NaCl solution, and 2 cc. of toluene. The tubes were stoppered and maintained at atmospheric pressure (by means of a glass tube in the stopper) and were then incubated at 38°C .

One cc. portions of the incubated mixture were removed at various intervals and the quantity of

reducing sugars was determined by a method resembling Fehling's test involving the precipitation of cuprous oxide. (The method is described in detail.)

Quantitative determinations were made for cuprous oxide by a colorimetric method. By this means it was demonstrated that the amount of reducing sugar increased with the increased extension of time of incubation of the samples.

In the five rats tested, the cuprous oxide production (and correspondingly, the reducing sugar formation) varied from 0.05 to 0.50 mg. after 4 hours incubation (control of starch alone, 0.10 mg.) to 0.60 to 2.9 mg. at 124 hours (control of starch alone, 0.40 mg.).

Cole, Sydney W., 1903. CONTRIBUTIONS TO OUR KNOWLEDGE OF THE ACTION OF ENZYMES. PART I. THE INFLUENCE OF ELECTROLYTES ON THE ACTION OF AMYLOLYTIC FERMENTS. *Jour. Physiol.*, 30 (2): 202-220.

The effect of varying amounts of acids and of neutral salts of monobasic acids on the action of ptyalin obtained from human saliva was studied.

Coleman, Roger D., and M. D. Appleman, 1953. ANTIBODIES OF SYPHILIS IN SALIVA AND SERUM. *Jour. dent. Res.*, 32 (2): 294-297.

The serum and saliva of 31 persons with treated syphilis and 10 persons with untreated syphilis were tested using the Kahn, Mazzini, and VDRL flocculation tests and the Kolmer complement fixation test. The reagin antibodies of saliva were demonstrated occasionally with these serodiagnostic tests but saliva was generally less sensitive than serum. Antibody presence in saliva apparently is not correlated directly with the blood titer, and the antibodies are less concentrated in the saliva of treated patients.

Collins, K. H., and A. L. Tatum, 1925. A CONDITIONED SALIVARY REFLEX ESTABLISHED BY CHRONIC MORPHINE POISONING. *Amer. Jour. Physiol.*, 74 (1): 14-15.

In the course of a study on chronic morphinism, a conditioned salivary reflex primarily initiated by morphine was observed. Dogs were given subcutaneous administrations of morphine sulfate daily. A small amount (30-80 mg.) produced salivation. After 7 or 8 daily doses of the drug, the dogs salivated profusely before the morphine was administered. Salivation began upon the entrance of the experimenter into the dog room and became more copious at the sight of the hypodermic syringe. The authors state that salivation is not secondary to nausea, which would impair swallowing, as evidenced by the fact that the dogs were observed to drink and on a few occasions eat during the period of salivation.

Eight dogs were observed to have developed this reflex after 7 or 8 days and 1 cat after 14 days. 3 of the dogs had received morphine daily for a period of 4 months and salivation could still be induced by the sight of a hypodermic syringe.

Colvin, Merl G., 1932. AIR DISSEMINATION OF BACTERIOPHAGE IN RELATION TO AIR-BORNE INFECTION. *Amer. Jour. Hyg.*, 15 (1): 247-259.

The air-borne transmission of bacteriophage by means of dust and droplets was studied.

In a preliminary experiment, one individual, after rinsing his mouth with 5 cc. of a bacteriophage suspension or lysate (ca. one billion "corpuscles" of bacteriophage of *Bacillus megatherium*/cc.), was introduced into a small laboratory room

with six test persons. After 1-2 hours exposure, the respiratory tracts of the individuals were consistently negative for bacteriophage. The role of talking, sneezing, and coughing in the transmission of phage was demonstrated by pour-plate studies. Talking directly over freshly-seeded aga plates, immediately after oral rinsing with lysate containing 3-4 billion corpuscles, caused no inhibitory plaques to appear over a 5-minute period at distances from 60 cm. to 15 cm.; after 10 minutes at 15 cm., 46 plaques appeared. Coughing directly over the plates at 30 cm. produced 10 plaques; sneezing at 30 cm., 1000 plaques.

Comroe, Bernard I., 1934. SALIVARY CHANGES IN SYSTEMIC DISEASE. Dental Cosmos, 76 (5): 563-569.

Salivary leukocyte counts, determined by Isaacs' [1927m] method, in 25 healthy individuals were compared to those determined in 211 patients. Variations ranged from 2 to 21,000 leukocytes/cc. of saliva. Wide variations were noted between normal individuals, and in the same individual at different times under normal conditions, after injection of adrenalin or of typhoid vaccine; no significant relationships were found. A short literature review of the chemical and microscopic contents of saliva is presented.

Cook, Geo. W., 1905. THE EFFECTS OF CHEMICAL AGENTS ON BACTERIA WITH RELATION TO THE SALIVA. Dental Cosmos, 47 (1): 83-89.

The effects of O₂, CO, CO₂, NH₄, chloroform, chloral, carbon disulfide, and various alcohols were studied on the diphtheria bacilli [*Corynebacterium diphtheriae*], typhoid fever [*Salmonella typhosa*], glanders [*Malleomyces mallei*], cholera [*Vibrio comma*], and *Bacterium mycoides*. Use of saliva as the solvent material was found to increase the toxicity of such chemicals. Changes in the osmotic pressure of saliva above or below 5.5 to 7.5 atmospheres also increased the deleterious effects. Differences were noted between the effects produced by salivary and bouillon solutions containing heavy metal ions, which increased irritability of the cell protoplasm. Differences were also noted between solutions containing salivas of different persons. *Bacillus pyocyaneus* [*Pseudomonas aeruginosa*] formed pigment in saliva of 8 of 10 persons. Pigment was also produced in artificial saliva containing all the constituents considered to be present in normal saliva, by addition of asparagin. Potassium thiocyanate also appeared to affect growth and pigmentation of bacteria in natural and artificial salivas. Saliva, freed of normal inorganic salts by dialyzation and of bacterial organisms, was tested in solutions containing various organisms. Saliva from 3 of 10 persons contained a bacteriolytic substance, which caused changes in morphology, loss of pathogenicity, and eventually death of bacteria. It is concluded that certain agents, present in saliva either as normal constituents or as foreign substances, have great influence on growth and physiological activity of bacteria.

Cooper, Ethel, 1923. THE DISTRIBUTION OF THE VITAMINE A IN THE URINE AND THE DIGESTIVE SECRETIONS (MAN, DOG). Proc. Amer. physiol. Soc., 63 (3): 425.

A series of tests was made on the distribution of vitamin A in the urine and digestive juices in

man. Even when the subjects were on a vitamin-A rich diet, little or no vitamin A occurred in the saliva.

Cordier, D., and G. Cordier, 1948. ACTION PHARMACOLOGIQUE DU SULFUR D'ÉTHYLE DICHLORÉ (YPERITE) SUR LES GLANDES SALIVAIRES [Pharmacological effect of dichloroethyl sulfide (yperite) on the salivary glands]. Compt. rend. de la Soc. de Biol. (Paris), 142 (17-18): 1117-1120.

Chloralosed cats and dogs received yperite intravenously, intraperitoneally or subcutaneously to study the effects on salivation. Saliva flow and delay of response to the drug was found to vary with the gland and with the dose and mode of injection. Response was most rapid and flow most abundant in the submaxillary gland, less abundant and more retarded in the parotid, and insignificant in the retrolingual gland. The hypersecretion was determined to be of peripheral rather than reflex origin. In a study of the effects of yperite on the chorda tympani, tests using faradic stimulation of the chorda showed a primary phase of hypersensitivity followed by a phase of increasing paralysis of the nerve.

Atropine administered to the cat before yperite, was found to inhibit salivation; atropine administered after yperite, either before or after the start of hypersecretion, had no inhibitory effect. Administration of pilocarpine during the stage of increasing paralysis of the chorda did not effect the slackening of hypersecretion characteristic of this phase.

Cordier, D., and G. Cordier, 1949. ACTION DE LA TRICHLOROTRIETHYLAMINE (YPERITE A L'AZOTE) SUR LA SECRETION SALIVAIRE [Action of Trichlorotriethylamine (nitrogen yperite) on salivary secretion]. Compt. rend. Soc. Biol. (Paris), 143 (7-8): 490-492.

Aqueous solutions of nitrogen yperite were injected into the jugular vein of chloralosed dogs and cats and the resulting salivation determined from the cannulated submaxillary duct. A strong dose of nitrogen yperite (10-20 mg./kg.) caused little salivation and rapid death, while a weak dose (1 mg./kg.) produced abundant salivation which progressively decreased to stop before death of the animal. No relationship was found between the size of the dose and the lag period between injection and salivary response. Similarity in response from intact and denervated glands indicates a peripheral mode of action by the drug. The drug was found to cause no change in the excitability of the chorda during the latent period, to increase excitability of the nerve during the initial phase of hypersecretion and to eventually produce delayed paralysis of the secretory nerve. Subcutaneous injection of 25 mg./kg. of atropine 20 minutes prior to a 10 mg./kg. dose of nitrogen yperite inhibited salivation; administered during the period of hypersecretion, strong doses of atropine caused slight, temporary diminution in salivation. Pilocarpine had no effect on salivary secretion when injected intravenously after the chorda no longer responded to electrical stimulation. The secretory effect of yperite and of nitrogen yperite is of peripheral origin.

Cordier, D., and G. Cordier, 1949a. MODIFICATIONS DE LA PERMEABILITÉ GLANDULAIRE AUX MATIÈRES COLORANTES AU COURS DE L'INTOXICATION PAR LE

SULFURE D'ÉTHYLE DICHLORÉ (YPERITE)[Modifications of glandular permeability to dye substances during dichloroethyl sulfide (yperite) poisoning]. *Compt. rend. de la Soc. de Biol. (Paris)*, 143 (15-16): 1048-1050.

Indigo carmine administered intravenously is not excreted by the salivary glands under normal circumstances. When the administration of indigo carmine (5 cc. of a sat. sol.) to dogs was followed after 20 minutes by an injection of yperite (mustard gas) (20 mg./kg. of body weight at 20-minute intervals until death), the dye appeared in the submaxillary saliva 30 minutes after injection of the poison. Elimination of dye in the saliva attains a maximum after 70 minutes and maintains this level until death of the animal. The authors conclude that yperite modifies the permeability of the secretory acini of the submaxillary gland.

Cordier, D., and G. Cordier, 1949. ACTION DE LA TRICHLOROTRIÉTHYLAMINE (YPERITE A L'AZOTE) SUR LES GLANDES SALIVAIRES. VARIATIONS DE LA COMPOSITION CHIMIQUE DE LA SALIVE [Effect of trichlorotriethylamine (nitrogen yperite) on the salivary glands: variations of the chemical composition of the saliva]. *Compt. rend. de la Soc. de Biol. (Paris)*, 143 (15-16): 1079-1080.

Intravenous administrations of strong or weak doses of nitrogen yperite (nitrogen mustard) (13 mg. and 5 mg./kg. of body weight, respectively) to chloralosed dogs induced a flow of submaxillary saliva rich in solids (1.8%) and organic matter (0.1%). The effect is similar to that produced by yperite.

Corkhill, A.B., 1925. THE ESTIMATION OF THE SALIVARY UREA AS AN INDEX TO RENAL PROGNOSIS. *Med. Jour. Austral.* 1925 (10): 236-238.

A method of determining and applying the salivary urea content as an aid in the diagnosis of renal conditions is described. An approximate index of the urea content of the blood may be obtained thereby.

In 10 patients (5 healthy, 2 with rheumatoid arthritis, 1 with gastric ulcers, 1 with diabetes insipidus, and 1 convalescent from empyema), the salivary index in terms of mercuric chloride [number of cc. of 5% mercuric chloride to produce color per 100 cc. saliva] was between 30-50.

Four case histories in which the method was applied are presented.

Cornil, L., and J. Malméjac, 1938. SUR LA SÉCRÉTION SALIVAIRE SOUS-MAXILLAIRE PROVOQUÉE PAR L'HISTAMINE [On submaxillary salivary secretion induced by histamine]. *Compt. rend. Soc. Biol. (Paris)*, 129: 680-681.

Study of the salivary effects of intravenous injection of histamine hydrochloride in the chloralosed dog showed that a strong dose (0.5 to 1.0 cc. in a 12 to 14 kg. dog) was required to produce submaxillary salivation. The enervated gland secretes 10 to 12 drops in response to the drug. Similar tests in the curarized dog showed abundant salivation lasting 3 to 4 minutes to be obtained by intravenous injection of 0.5 to 1.0 mg. of histamine in a 12 to 15 kg. dog, in spite of the hypotension induced by the drug. Chloralose anesthesia is considered to substantially impede the salivary action of histamine. Secretion of the enervated submaxillary gland (severed chorda and cervical sympathetic) is notably inferior to that

of the opposite intact gland. Injection of 0.05 to 0.1 mg. of histamine into the common carotid, ipsilateral to the enervated gland, produced a more intense and rapid secretion in the intact than in the enervated gland; the same procedure after ligation of the internal carotid had considerably less effect on the intact gland. Salivary effects are also considerably diminished if similar arterial injection and ligation are performed on the intact side.

Histamine is considered to have complex action of the submaxillary gland, its effects being produced mainly by way of the central nervous system.

Costich, Emmett R., and John W. Hein, 1952. A CLINICAL STUDY OF THE EFFECTS OF A TOOTH PASTE CONTAINING SODIUM COPPER CHLOROPHYLLIN ON ORAL BACTERIA AND GINGIVAL DISEASE. *Jour. dental Res.*, 31 (4): 474-475.

"One hundred and fourteen women, 19 to 22 years of age, were divided into 2 similar groups on the basis of detailed gingival examinations. At the end of 1 month they were given a second series of control examinations and then assigned to either a control tooth paste or the same tooth paste containing 0.1 per cent sodium copper chlorophyllin. Duration of study was 6 months. Tests or examinations were performed at monthly intervals for the following: gingival pathology, salivary lactobacilli, salivary odor, amount of stains, and amount of oral debris. In addition, for the final 4 month period, streptococcus counts, salivary pH and salivary acid production from glucose were determined at monthly intervals. The material was analyzed by means of I. B. M. punch cards. No significant differences between the control and experimental groups were found for any of the factors tested." (Complete paper.)

Cove-Smith, R., and Alan Moncrieff, 1935. DEFECTIVE SALIVA. *Proc. roy. Soc. Med., Disease in Children*, 29: 126-127.

The case of a 16-month old boy, lacking both saliva and tears since birth, is discussed. A clinical examination, particularly of the oral cavity, revealed no abnormalities. When the subject was given a lemon to suck, no salivary flow was stimulated. A mucus sample was void of ptyalin. No conclusions were reached.

Cowgill, George R., and Lafayette B. Mendel, 1921. STUDIES IN THE PHYSIOLOGY OF VITAMINS. I. VITAMIN-B AND THE SECRETORY FUNCTION OF GLANDS. *Amer. Jour. Physiol.*, 58 (1): 131-151.

The effect of various solutions containing vitamin B (extracts of rice polishings, navy bean, yeast, wheat embryo) on the secretory function of the salivary glands was studied. One group of dogs was fed a normal mixed diet and another, a vitamin-B-free diet. Saliva, obtained from the submaxillary and sublingual ducts by cannulation, was compared with that of control animals in which the chorda tympani nerve had been stimulated and which had received pilocarpine injections. There was no direct relationship between vitamin B and the secretory activity of the salivary glands.

Cox, Gerald J., 1940. THE FLUORINE AND DENTAL CARIES PROBLEM. *Jour. Amer. dent. Assoc.*, 27 (7): 1107-1114.

A review of the relationship of fluorine to dental caries discusses the effects of fluorine on saliva, oral bacteria, and structural resistance of dental enamel to caries.

Crisler, George, 1928. THE EFFECT OF WITHDRAWAL OF WATER ON THE SALIVARY CONDITIONED REFLEX INDUCED BY MORPHINE. *Amer. Jour. Physiol.*, 85 (2): 324-331.

Withholding of drinking water over a 3 to 5 day period practically abolished a morphine-induced reflex secretion of saliva in 3 dogs. Unconditioned salivation, induced by pilocarpine or morphine, was also reduced but to a lesser degree than the conditioned secretion. Depression of the morphine-induced salivary conditioned reflex was greater during periods of dehydration with food ad libitum than during starvation with water ad libitum, indicating the water factor to be more important than starvation in the reflex depression.

Crisler, George, 1930. SALIVATION IS NECESSARY FOR THE ESTABLISHMENT OF THE SALIVARY CONDITIONED REFLEX INDUCED BY MORPHINE. *Amer. Jour. Physiol.*, 94 (3): 553-556.

A study was made of the salivary conditioned reflexes of five dogs in whom fistulas of the submaxillary duct were used to collect the saliva samples. Atropine was used to depress and morphine to stimulate salivary secretion, and pilocarpine to continue the effector response to salivation.

Atropine given alone in 2 mg. doses over a period of 30 days did not produce conditioned or unconditioned salivation. Morphine, however, caused a conditioned secretory response after atropine withdrawal and after a fully-formed conditioned reflex had been established, thus, indicating the presence of a conditioned reflex in the absence of an effector stimulus. The conditioned reflex disappeared if pilocarpine was injected to produce a continuation of the effector response as a substitute for morphine, after the development of a conditioned reflex to morphine and in the absence of atropine administration. Results thus show that the morphine-induced conditioned reflex was not annulled by a continuation of the effector response.

Crisler, George, W. T. Booher, E. J. Van Liere, and J. C. Hall, 1932. THE EFFECT OF FEEDING THYROID ON THE SALIVARY CONDITIONED REFLEX INDUCED BY MORPHINE. *Amer. Jour. Physiol.*, 103 (1): 68-72.

Eleven dogs were prepared and conditioned with morphine. Control data was obtained from 6 daily runs, and the animals were then given 2.5-3 grams of Armour's desiccated thyroid substance daily during the experimental period of 7-18 days. Results showed that a stimulation of the conditioned salivary secretion occurred, followed by a depression of this secretion. An unconditioned salivary secretion was not influenced by thyroid feeding. Cerebral stimulation appeared to be involved in the stimulation of the conditioned salivary secretion, which was followed by a tissue dehydration, resulting in a depression of the secretory rate. Raising the metabolic rate artificially, by use of the thyroid, did not make the conditioned reflex more pronounced.

Crisler, George, 1935. AVITAMINOSIS-A AND THE SALIVARY CONDITIONED REFLEX INDUCED BY MORPHINE. *Amer. Jour. Physiol.*, 115 (1): 215-218.

A study of the effect of avitaminosis-A upon the salivary conditioned reflex caused by morphine was studied in 4 fistulated dogs. Both conditioned and unconditioned control secretion rates for morphine were established. Vitamin A was excluded

from the diet for periods up to 30 days, after which it was included. From observations on the test animals, it was concluded that the salivary conditioned reflex induced by morphine was depressed by the avitaminosis-A. The morphine unconditioned secretion of saliva was not significantly influenced by the avitaminosis-A. Water consumption remained constant throughout the experiment as did the body weights of the animals, the author concluded that neither anorexia nor adipsia caused the depression. It was felt that the depression of the salivary conditioned reflex caused by morphine occurred because of the effect of the avitaminosis-A upon the new, conditioned center in the brain of each of the experimental dogs.

Critchley, Macdonald, and S. P. Meadows, 1933. XEROSTOMIA AND XEROPHTHALMIA. *Proc. roy. Soc. Med.*, 26 (3): 308-309.

A report is made of a woman, aged 61, suffering from xerostomia and xerophthalmia. A subcutaneous injection of 1/10 grain of pilocarpine nitrate produced no saliva or sweating. Histological examination of a parotid gland showed a chronic inflammatory condition to exist, with large numbers of leukocytes which replaced glandular tissue.

Crittenden, Phoebe J., 1939. EFFECTS OF ANESTHETICS ON THE RESPONSE OF SUBMAXILLARY AND PANCREATIC GLANDS TO PROSTIGMINE AND PHYSOSTIGMINE. *Proc. Soc. exper. Biol. Med.*, 41 (2): 367-370.

A study was made of the effects of anesthesia (chloralose, paraldehyde) upon the secretory response of the submaxillary gland after administration of prostigmine and physostigmine. In lower doses (below 0.1 mg/kg.), prostigmine is a greater stimulant than physostigmine; above 0.1 mg/kg., a "reversal" in the glandular response occurs. Both paraldehyde and chloralose effect significant decreases in the submaxillary secretory response to prostigmine and physostigmine.

Crowley, Mary C., and U. G. Rickert, 1935. METHOD FOR ESTIMATING BACTERIAL CONTENT OF MOUTH BY DIRECT COUNT. *Jour. dental Res.*, 15 (3-4): 169-170.

"Material was obtained by brushing the teeth and then rinsing the mouth. No food was taken during an 8-hour period, which was started two hours before the first count, after which counts were made at 3- and 6-hour intervals. The method was similar to that used by Breed and Brew for direct bacterial counts in milk, with the exception that an atomizer was devised to break up clumps of bacteria. Dilute NaOH was used to dissolve mucin, one of the causes of clumping. The atomizer, attached to compressed air, forced a constant stream of fluid through a 100-mesh copper screen. Mouth washings were sprayed for one-half hour. The difference between counts of two preparations from each of thirty-four samples averaged 13 percent. Counts showed variations at different times of the day, and on different days. No 'diurnal tide' was observed." (Complete paper).

Crowley, Mary C., and U. G. Rickert, 1935a. A METHOD FOR ESTIMATING THE BACTERIAL CONTENT OF THE MOUTH BY DIRECT COUNT. *Jour. Bacteriol.*, 30 (4): 395-400.

A new method for estimating the bacterial content of the mouth was developed, employing an atomizer to eliminate bacterial clumping.

The teeth of the test persons were thoroughly brushed and their mouths rinsed with 10 cc. of distilled water; the mouth washings, and washings taken from the toothbrushes were transferred to an atomizer and were sprayed for 30 minutes and the spray collected. Due to a loss of 4 to 7 cc. by evaporation, distilled water was added to bring the volume up to 20 cc. 0.01 cc. samples of the washings were transferred by means of a calibrated pipette to slides having etched lines forming 2 areas of 1 cm. square. The samples were spread evenly over the square cm. area, dried, and Gram-stained.

The number of bacteria was determined by averaging the direct counts of 4 ocular fields.

The effect of spraying was observed in the counts of 3 individuals in which an increase of at least 36% in bacterial count occurred over those entailing unsprayed material. Treatment with N/40 NaOH insured a better distribution of bacteria, although no significant increase in count resulted.

Great variation occurred in the same (3) individuals at different times of the day and on different days.

Crowley, Mary C., and U. Garfield Rickert, 1937. EFFECT OF CERTAIN MOUTHWASHES ON THE NUMBER OF ORAL BACTERIA. *Jour. dental Res.*, 16 (6): 531-535.

Six popular mouthwashes (Zonite, Pepsodent, Chlorozene, Listerine, Lavis, and hexylresorcinol), and a new mouthwash, Azochloramid, were tested for antibacterial action against the oral bacteria in six persons.

In the first of two experiments, Lavis, Pepsodent, hexylresorcinol, and Azochloramid were applied to the oral cavity in the greatest concentrations suggested by the manufacturers. The efficacy of the washes was determined by comparing the average of bacterial counts taken on treatment days with the average of counts made on control days; counts were taken immediately after, and 3 and 6 hours after use of mouthwash. In the four cases in which Pepsodent was applied, a reduction of bacteria occurred; in one instance, a 1:1 dilution produced a 40% decrease from the control count. Azochloramid showed a good reduction in several cases. In two cases, an increase of bacteria was observed after Listerine application.

In the second experiment, Azochloramid, Chlorozene, Zonite, and a 1:3 dilution of Pepsodent were tested on two individuals; none of the washes produced a marked decrease in either individual.

Because of the great variation in the same individual from time to time in both the experimental tests and the controls, the author states that no definite conclusions can be drawn as to the antiseptic value of the mouthwashes tested. (Advance abstract in: *Jour. dental Res.*, 16 (4): 315.)

Cuboni, Ettore, 1928. SUL POTERE ANTIISOEMAGGLUTINANTE SPECIFICO DELLA SALIVA [On the specific anti-isohemagglutinating power of saliva]. *Boll. dell'Ist. sieroter. milanese*, 7 (1): 15-23. In Italian, with German summary (p. 23).

Yamakami (1926) first recognized the property of the saliva of individuals of various blood groups to inhibit hemagglutination by sera of analogous agglutinating blood groups. The author performed several series of experiments using saliva of various blood groups mixed with various sera and observing the agglutinant action of the sera on erythrocytes of various blood groups. The

results (given in 4 tables) confirm Yamakami's findings. The author assumes that saliva, as well as other body fluids, contains agglutinogens derived from cells which are in contact with the fluids.

Cumming, James G., Charles B. Spruit, and Fritz A. Reuter, 1920. SALIVA-BORNE INFECTIONS: THEIR TRANSMISSION THROUGH EATING UTENSILS. *Modern Med.*, 2 (7): 502-507.

The importance of eating-utensils in saliva-borne infection is emphasized. A comparison of the efficacy of hand and machine dish-washing methods indicated that in 76 specimens, 78.82% of the bacteria were removed by hand, whereas in 22 specimens, 99.17% of the organisms were removed by machine.

Cumming, James G., 1930. SALIVA-BORNE DISEASE CONTROL: ERADICATION. *Milit. Surgeon*, 67 (4): 453-473.

An extensive review of literature on salivary transmission of diseases is presented; mess kit wash water, eating utensils, and hands are emphasized as prime factors in such transmission.

Curby, William A., 1953. DEVICE FOR COLLECTION OF HUMAN PAROTID SALIVA. *Jour. Lab. clin. Med.*, 41 (3): 493-496.

A description is given of a device, for the collection of human parotid saliva, which can be sterilized, avoids contamination with other oral secretions, and can be used to measure the rate of flow.

Cushman, F. H., J. W. Etherington, and G. E. Thompson, 1940. QUANTITATIVE RELATIONSHIP BETWEEN SALIVA-AND CARIES IN AN ADOLESCENT GROUP. *Jour. Dental Res.*, 19 (3): 298.

"As a continuation of the work started by Trimble, Etherington and Losch, 21 adolescent patients (13-16 yrs.) were examined clinically with aid of radiographs at 1 year intervals by the same clinician. Paraffin stimulated salivary secretions for 10 minute periods were collected under similar conditions on repeated tests. Average secretion for the whole group 16.9 cc. Amounts ranged from 7-34 cc.: a. No new caries group-secretion range 16-34 cc., Av. 22.1 cc.; b. 1-3 new smooth surface cavities-secretion range 10-23 cc., Av. 16.3 cc.; c. 4 or more new smooth surface cavities-secretion range 7-16 cc., Av. 12.3 cc. A total of 55 samples from 24 individuals yields a total of 38 possible individual variations. Of this number, 24 did not vary more than ± 2.5 cc.; 32, nor more than ± 5 cc. No diagnostic significance can be attached to this relationship when considering individuals. The trend indicates, however, that some relationship does exist between caries susceptibility and salivary secretion and, to a large degree, amounts of secretion are reproducible under similar conditions." (Authors' abstract)

Cushman, F. H., J. W. Etherington, and G. E. Thompson, 1941. RELATIONSHIP OF SALIVARY SURFACE TENSION AND RATE OF FLOW TO DENTAL CARIES IN AN ADOLESCENT GROUP. *Jour. dent. Res.*, 20 (3): 251.

Measurements were made of salivary surface tension in 4-5 cc. samples of the unstimulated salivas of 26 individuals, collected 2-3 hours after meals after first rinsing the mouth. Readings were made of the samples, maintained at room temperature, with a clean, flamed loop as soon as practicable to avoid the increase in tension values incident to long standing. The increase

averaged less than 1 dyne during a 15-minute period. Surface tension values in 10 individuals with no new cavities averaged 49.6 (range 45.5-52.2), in 7 individuals with 1-2 new cavities, 51.8 (49.0-57.4), in 9 individuals with 4 or more new cavities, 54.6 (52.1-57.4). Ten-minute samples of stimulated saliva were collected from this same group on different days under similar conditions. The 10 subjects with arrested caries had an average flow of 20.6 cc. (range 15-27); the 7 subjects with 1-2 new cavities, 16.6 cc. (15-21); those with 4 or more new cavities, 10.1 cc. (5-15).

Da Rin, O., and M. Weinberger, 1928. LA RICERCA DI GLUCOSIO NELLA SALIVA DEI DIABETICI [Study of salivary glucose in diabetics]. *Clinica med. ital.*, n.s., 54 (2): 170-191. In Italian, with French summary (p. 191).

Literature data are reviewed on the composition of mixed saliva and on the excretory function of the salivary glands in regard to various blood constituents under normal, pathological, and experimental conditions. In 20 cases of diabetes, the authors determined glucose in the saliva in only one case. They assume that glucose appears in the saliva only when the glucose level of the blood is very high (above 5 per mille).

Da Rin, O., 1930. SULL'ATTIVITA LIPOLITICA DELLA SALIVA [On the lipolytic activity of the saliva]. *Clin. med. ital.*, 61 (4): 340-353.

Determinations were made of the lipase contents of mixed saliva, parotid saliva, and blood serum after fasting and after a meal, with and without pilocarpine stimulation, in normal and in diseased subjects (method is described in detail). Mixed saliva contains more lipase (0.1 to 0.3 units) than parotid saliva (maximum, 0.1 unit). There is no correlation between the lipase contents of saliva and serum. Stimulation of saliva flow by pilocarpine does not affect the lipase concentration of the saliva. After a meal, the lipase level of the saliva decreases. The lipase of mixed saliva is resistant to atoxyl. Salivary lipase is diminished in acute or chronic febrile diseases; is increased in duodenal ulcer, cholecystitis, and gastric cancer; and is not significantly affected in diabetes mellitus.

Dagaeva, L. N., 1955. ZNACHENIE SLIUNY V MINERAL'NOM OBMENE EMALI ZUBA [The importance of saliva in the metabolism of the tooth enamel]. *Stomatologiya*, 5: 17-21.

Radioactive calcium was administered to dogs enterally or parenterally to study the role of saliva in dental metabolism. Measurement of dental tissue, in impulse/min. after 10 mg. Ca, showed the enamel of pulpectomized and filled teeth to contain radioactive calcium; crown and root dentin contained only traces of radioactivity. The enamel of teeth protected from saliva by metallic caps showed practically no radioactivity, while uncapped control teeth did. The traces of radioactivity in the enamel of capped teeth is attributed to penetration of Ca from the pulp by means of the dentin-enamel border to the enamel. No radioactivity could be detected in the enamel or dentin of pulpectomized teeth, which were capped prior to administration of the radioactive Ca; traces of radioactivity in the root dentin of such teeth were apparently due to penetration of the element through the pericementum

and cement. Much greater radioactivity was found in the dentin of teeth from which the enamel has been partially removed before introduction of the radioactive Ca, than in control teeth without exposed dentin.

The above results indicate the physiological role of saliva, supplying the enamel with the needed mineral components, playing apparently the same role in regard to enamel as the blood plays to dentin, although it is possible that some calcium atoms also penetrate into the enamel from the dentin. The enamel has a barrier function in regard to dentin, preventing the penetration of the indicator into the dentin from the saliva; when partially bared of its enamel, the dentin includes much more calcium than normally. The saliva is the main source of calcium salts for the enamel; the dentinal canaliculi contribute to this supply in a small measure.

Dale, H. H., and P. P. Laidlaw, 1910. THE PHYSIOLOGICAL ACTION OF B-IMINAZOLYLETHYLAMINE. *Jour. Physiol.*, 41 (5): 318-344.

Injections of B-aminazolyethylamine were administered to various experimental animals and the physiological effects of the following were noted: the intact animal, uterus, urinary bladder, vascular system, respiratory system, plain muscle, stomach, intestine, striped muscle, and gland cells (salivary gland, pancreas, and kidney). The main manifestations of the drug is its action on plain muscle, but it also causes slight salivation which can be annulled by atropine.

Dale, H. H., and P. P. Laidlaw, 1911. NOTE ON A REVERSED ACTION OF THE CHORDA TYMPANI ON SALIVARY SECRETION. *Jour. Physiol.*, 43 (2): 196-198.

A reversed action of the chorda tympani on salivary secretion is described. The action of cystine on the chorda produced a more rapid flow of saliva; cessation of the stimulation was followed by a further increase in salivary flow. Renewal of the stimulus caused a return to the original stimulated rate of flow.

Dale, Peter P., 1948. CARIES STUDIES IN DESALIVATED RATS RECEIVING IODOACETIC ACID PARENTERALLY. *Jour. dent. Res.*, 27 (6): 757-758.

Caries production was studied in 42 female litter mate albino rats, aged 25 to 30 days. Three groups of 14 animals each were used: group I served as control, group II were desalivated, and group III were desalivated and received subcutaneous injections of 1 cc. of 400 ppm. iodoacetic acid every second day. The average caries scores were: group I, 14.0; group II, 46.8; and group III, 35.7. Desalivation caused a reduction in the weight and water consumption of the animals and increased the incidence of caries; parenteral iodoacetic acid was mildly effective in limiting caries.

Danilova, T. I., 1951. SODERZHANIE KALTSIIA V NEKOTORYKH PISHCHEVARITEL'NYKH SOKAKH SOBAK [The calcium content of some digestive juices in dogs]. *Trudy 3-ei Uzbekistan. Konf. Fiziol., Biokhim. i Farmakol.*, Tashkent, 1951, p. 207. *Abst.: Sovet. med. refer. Obozrenie, Fiziol.*, 1953 (15): 103.

The calcium content of salivary and gastric secretions, studied in 2 dogs with fistulated salivary glands and in 2 dogs with isolated ventricle, was found to depend on the diet. Parotid saliva usually contains more calcium than submaxillary,

which in turn contains more than gastric juice. The calcium content in saliva and in the gastric juices changed after heating the dog by exposure to solar radiations.

Davenière, Portier, et Pozerski, 1898. SUR L'AMYLASE ET LA MALTASE DE LA SALIVE, DU PANCRÉAS ET DE L'INTESTIN GRÉLE DES MAMMIFÈRES [On the amylase and maltase of the saliva, of the pancreas, and of the small intestine of mammals.] Compt. rend. de la Soc. de Biol. (Paris), 50 (16): 514-515.

Experiments on human saliva demonstrated the presence of amylase and maltase. The maltase was not very active.

Davies, G. N., G. L. Slack, and E. B. Tilden, 1948. A MEDIUM FOR THE DIFFERENTIATION OF STRONGLY ACIDOGENIC FROM WEAKLY ACIDOGENIC ORGANISMS OF HUMAN SALIVA. Jour. dent. Res., 27 (2): 149-153.

A preliminary report is given of a new medium and a method for the quantitative differentiation of strongly acidogenic from weakly acidogenic organisms of human saliva. The media supported the growth of different types of bacteria (lactobacilli, streptococci, spore-forming rods) but allowed the clear cut differentiation of strongly acidogenic from weakly acidogenic, non-acidogenic, or alkali-producing organisms. Preliminary experiments on the use of the medium as a test for caries susceptibility are included.

Davies, Muriel, and James J. Rae, 1948. A NOTE ON THE ESTIMATION OF PHOSPHATE IN SALIVA. Jour. dental Res. 27 (2): 167-168.

Thirty-five samples of saliva were examined for phosphate content. The method of colorimetric measurement of total phosphate and organic phosphate is described.

The total phosphate content ranged from 9.3 to 18.7 (average, 12.9) mg./100 cc., that of organic phosphate from 0.40 to 1.75 (average, 1.15) mg./100 cc., the inorganic phosphate constituting the difference between the two measured values.

Compared with Lura's data (1947m) on the same subject, the results appear to be more uniform, (cf. Lura, 1948m).

Davis, G. H. G., and K. A. Bisset, 1956. THE ISOLATION AND CLASSIFICATION OF LACTOBACILLUS SPECIES FROM HUMAN SALIVA. Jour. Dent. Res., 35 (6): 964-965.

The spectrum of Lactobacillus species found in 66 Italian saliva samples collected in Rome was similar to those reported for American, Scandinavian, and English salivas. Of 368 strains isolated, 357 were classified into the following species: *Lactobacillus casei*, *L. planatarum*, *L. salivarius*, *L. acidophilus*, *L. fermenti*, *L. brevis*, and *L. buchneri*. The classification system used was a simplified version of Davis'. The most commonly occurring lactobacilli were of the *L. casei*, *L. acidophilus*, and *L. fermenti* types. Strains of *L. brevis* were of 2 distinct types, one being the common saprophytic *L. brevis* of cheese, silage, etc., and the other, which occurred more regularly in the mouth, being apparently truly parasitic and thus resembling *L. acidophilus*. Strains of all the other 5 species occur in non-oral sites. The incidence of *L. acidophilus*, *L. brevis*, and *L. buchneri* was significantly greater in samples after 96-hour enrichment culture in T. J. broth than in the same samples after only

24 hours, emphasizing the importance of adequate technics in surveys of this type. Five samples yielded strains of *Leuconostoc*, an organism not previously recorded from saliva. Of 19 salivas from caries-free mouths, 7 were apparently devoid of lactobacilli. Seven of the 47 carious salivas also yielded no Lactobacilli. The relatively high proportion of Lactobacillus negative samples in the caries-free group is an interesting feature of these results. (Author's abstract.)

Dawson, Clarence E., and Wilson Blagg, 1948. THE EFFECT OF HUMAN SALIVA ON THE CHOLERA VIBRIO IN VITRO: A PILOT STUDY. Jour. dental Res., 27 (5): 547-552.

Unstimulated saliva samples from 6 cholera patients and 15 normal persons, were tested *in vitro* for antibacterial activity against *Vibrio comma* by pour plate inhibition.

An inhibitory agent was present in all samples of normal saliva, varying in the same individual from time to time. 75% of the antibacterial action occurred during the first 2 hours of contact with the cholera vibrio in the cultures.

The cholera-patient saliva showed little or no antibacterial activity; those samples which were totally devoid appeared to stimulate growth of the cholera vibrio.

The agent was filterable (Seitz filter); was bactericidal to both cholera and typhoid bacilli; was destroyed by heating at 75° C. for 5 minutes and by centrifugation at 3,000 r. p. m. for 30 minutes; was partially inactivated after incubation at 37° C. for 24 hours, and by refrigeration at 8° C. for 14 days; and was completely inactivated by 1/800 N acid.

Only 1.7% of the saliva cultures were positive for cholera vibrio.

Dawson, C. E., and W. Blagg, 1949. FURTHER STUDIES ON THE EFFECT OF HUMAN SALIVA ON THE CHOLERA VIBRIO, IN VITRO. Jour. dental Res., 28 (6): 666-667.

"Previous studies revealed evidence that saliva from normal healthy individuals contained one or more agents which exhibited antibacterial properties on the cholera vibrio *in vitro*. Saliva from a cholera-infected group showed little or no antibacterial properties against the test organisms. In general, cholera infection with high morbidity was limited to the malnourished classes. These correlations prompted analysis into the antibacterial effectiveness of saliva from healthy and malnourished individuals. Stimulated and unstimulated saliva was collected from 20 healthy and 10 malnourished subjects, and filtered by means of aluminum oxide, glass wool adsorption columns. By a method which makes use of spectrophotometry and plating for determining the antibacterial powers of saliva, results were obtained which indicated that saliva from normal healthy individuals contained at least two active principles capable of inhibiting and lysing the cholera vibrio. These active principles could not be demonstrated with the same degree of potency in malnourished individuals or acute cholera patients. It is felt that the antibacterial titer of saliva might serve as an indication of the effectiveness of other body fluids, namely intestinal secretions. The findings offer a possible explanation as to why acute symptoms of cholera are for the most part confined to the malnourished peoples, and the control of cholera

is more of a social and economical problem than a medical one." (Complete paper.)

Dawson, Clarence E., and Wilson Blagg, 1950. FURTHER STUDIES ON THE EFFECT OF HUMAN SALIVA ON THE CHOLERA VIBRIO IN VITRO. *Jour. dental Res.*, 29 (2): 240-254.

It is stated that series of saliva filtrations (aluminum oxide adsorption column) indicated the presence of two different active principles in saliva, designated simply as the "first" and "second" active principles.

The effects of these two principles on cholera vibrio and eight other bacteria were studied by plate cultures and by measuring the degree of lysis by changes in optical density of bacterial suspensions with a Beckman spectrophotometer. The two principles "varied considerably in their bactericidal effects."

Non-stimulated saliva was more inhibitory than stimulated whole saliva; the respective filtrates did not differ in activity from one another.

No differences were observed between the active principles when they were subjected to various conditions. Both principles were partially inhibited by heating at 75° C. for 5 min. and were completely inhibited by 100° C. for 15 min. Incubation (up to 12 days at 37° C.), refrigeration (at 6° C. for 5 months, or at 0° C. for 24 hrs.), radiation (ultra-violet "at 16 inches" for 1-4 hours) and centrifugation (various rates and times) had no effect on either principle; ultra-violet radiation for over 4 hrs. at 16 inches caused a slight decrease in lytic action in both, but no change in bacteriostatic effect.

The sterile filtrate of whole saliva had a bacteriostatic effect on cholera vibrio, though of a lower titer than that shown by the first or second active principle.

The inhibitory effects of both principles were unaffected by pH between 3.1 and 11.3.

It was impossible to precipitate either principle with any of the agents used (i.e., ether, chloroform, acetone, hydrochloric acid, sulphuric acid, phosphoric acid, etc.); precipitation took place in whole saliva by all the reagents.

Activated charcoal was the only substance which adsorbed both principles; kaloin and aluminum oxide were ineffective.

Both principles were negative for protein (biuret test), amylase (methods of Fabicus-Møller and of Somogyi), carbohydrazase (sugar fermentation), urea (Karr's method), and cholesterol; whole saliva was positive for all of these.

Both principles were positive for lipase. In a qualitative test, fatty acids liberated when 1 ml. of each principle was incubated with an emulsion of olive oil in water containing gum acacia were titrated with 0.05N NaOH (phenolphthalein as indicator). The first principle gave a titration value of 0.25 ml. (average); the second, 0.42 ml. When measured quantitatively for lipid phosphorus, the first and second principles "contained 2.6 and 2.9 mg./100 ml. of filtrate respectively."

The phospholipid content and antibacterial effect of plasma and of stimulated salivas from 10 healthy persons (controls) and from 10 malnourished individuals were compared: In all instances, plasma and salivary phospholipid contents of the control group (averages of 7.22 and 1.75 mg./100 ml., respectively) was higher than that of the malnourished group (4.75 and 0.48 mg./100 ml., respectively.)

Spectrophotometric studies showed that the salivary filtrate of the malnourished individuals possesses little or no lytic power, while that of the healthy individuals was actively lytic. No bacteriostatic action on cholera vibrio was exhibited by saliva filtrates from the malnourished group.

The authors conclude:

"Under the conditions of the experiments, saliva from normal healthy individuals was found to have two antibacterial agents. These agents varied in their antibacterial specificity and exhibited both bacteriolytic and bacteriostatic properties against the cholera vibrio and several other organisms which were tested. The agents appeared to be components of salivary secretions and to be enzymic in nature. The results indicated that there was more constancy in the antibacterial action of saliva filtrates than that of whole saliva. Saliva filtrates from malnourished individuals and cholera patients revealed little or no antibacterial effect. This seems to indicate that the antibacterial properties of body secretions may play a dominant role in natural immunity to cholera infection."

Day, C. D. Marshall, 1934. THE AMYLOLYTIC ENZYME OF THE SALIVA IN RELATION TO DENTAL CARIES. *Dental Cosmos*, 76 (6): 683-689.

Unstimulated saliva was collected from the mouths of 110 eighth-grade school children (55 most "immune" to dental caries and 55 "most susceptible" from a group of 500 children) and indexed for ptyalin activity with a starch-iodine test. Results show the average amylolytic index of the caries "immune" group as a whole to be 13.2% higher than that of the caries susceptible group. This differential increased to 23% with comparison of indexes of the 30 most immune and 30 most susceptible children. Some connection between the amylolytic activity of saliva and incidence of dental caries is suggested.

Day, C. D. M., 1934a. AMYLOLYTIC ENZYME OF SALIVA IN RELATION TO DENTAL CARIES. *Jour. dental Res.*, 14 (3): 213-214.

The amylolytic activity of the salivas of one hundred 14-year-old children was observed. The salivas were divided into two groups according to the degree of caries immunity. Amylolytic activity was determined essentially by the method of Wohlgemuth.

Observations indicated that a relationship exists between the ptyalin index and dental caries, and that salivary amylase possibly plays at least a subordinate role in caries incidence. Amylolytic activity is unrelated to sex.

de Beer, Edwin J., and D. Wright Wilson, 1932. THE INORGANIC COMPOSITION OF THE PAROTID SALIVA OF THE DOG AND ITS RELATION TO THE COMPOSITION OF THE SERUM. *Jour. biol. Chem.*, 95 (2): 671-685.

The parotid ducts of normal, anesthetized (amylal) dogs were cannulated. Salivation was stimulated by intravenous or intraperitoneal injection of pilocarpine. Four 15-cc. samples were collected from each of the two parotid glands. pH and total carbon dioxide determinations were made immediately after samples were collected. Total solids were determined by drying the samples overnight at 100°.

All other determinations were made on ashed material. "Total carbon dioxide, calcium, and potassium were found to be present in the saliva in greater

concentration than in the blood serum, while sodium and chloride concentrations were lower in saliva than in the serum.

"The intravenous injections of solutions of calcium chloride and of sodium carbonate in quantities sufficient markedly to increase the concentrations of their respective ions in the blood were followed by increases in the concentration of these substances in the saliva.

"The injection of concentrated solutions of sodium chloride, potassium chloride, and potassium carbonate into the blood stream did not materially affect the composition of the saliva.

"The intravenous injections of either hydrochloric acid or of sodium carbonate resulted in an increase of the pH of the saliva." (From the authors' summary.)

Deakins, Martin, 1938. CATALASE IN SALIVA. Jour. dental Res., 17 (4): 294.

Salivary catalase was inactivated by heat, was equally divided between liquid and centrifugate after centrifugation, and increased in activity with storage. When filtered through a Berkefeld filter, the first 10 cc. of filtrate contained only about 1/3 of the enzyme. Paraffin-stimulation of salivary flow did not increase the catalase content proportionally. The concentration varied from individual to individual and in the same individual at different times.

Deakins, Martin, 1941. EFFECT OF STORAGE TEMPERATURE ON THE PRECIPITABLE PROTEIN CONTENT AND CATALASE ACTIVITY OF WHOLE SALIVA. Jour. dental Res., 20 (2): 129-131.

A study was made of the effects of temperature (room and ice-box) on the protein content and catalase activity of whole and centrifuged saliva. On standing 24 hrs. at 30° C., the protein content of whole saliva decreased 42%; the catalase activity was doubled. Under the same conditions, the protein content of centrifuged saliva decreased 34%; no catalase determinations were made. At 0° C., no significant change occurred in either protein content or catalase activity. Evidence indicates that 0° C. is the optimum temperature for both the collection and storage of saliva.

Deakins, Martin, V. D. Cheyne, B. G. Bibby, and M. Van Kesteren, 1941a. SIGNIFICANCE OF SALIVARY ANALYSES UPON SMALL GROUPS OF SUBJECTS. Jour. dental Res., 20 (3): 161-170.

"Eighteen different chemical and bacteriological studies [including determinations of total nitrogen, protein nitrogen, non-protein nitrogen, catalase activity, ptyalin activity, solids, ash, acid-neutralizing power, starch-fermenting power, bacterial counts, cell counts, bactericidal power, and organic buffer capacity] were made on 20 samples of stimulated, whole saliva taken from different subjects . . . and the results treated by the usual statistical methods.

"When the group was considered as a whole, no definite correlation could be found between any constituent studied and the rate of flow, either on an amount-per-cc. basis or on an amount-per-cc.-per-minute basis. . . . The range of any constituent was just as great on either basis; in fact, it was greater when the values were expressed on the rate-of-flow basis. . . .

"When divided into 'fast' and 'slow' groups of 8 cases each, throwing out the 4 cases nearest the

the mean for the group of 20, there was a significant difference between the rates of flow of total nitrogen, protein nitrogen, acid-neutralizing power, base-neutralizing power, total buffer capacity, total solids, total bacteria, and volume.

"When divided into 'old' and 'young' groups, 2 of the 8 significantly different constituents just mentioned were still significantly different and 3 others were on the verge of significance ($D/ad > 2 > 3$).

"When calculated on an amount-per-cc. basis, no correlation could be found between any constituent and either the rate of flow or age.

"The work emphasizes the difficulty of interpreting the results of salivary analyses from small groups, no matter how they are calculated." (Author's summary.)

Results are tabulated (Tables I, II, and III).

Dean, H. Trendlye, 1944. POST-WAR IMPLICATIONS OF FLUORINE AND DENTAL HEALTH. Amer. Jour. Public Health, 34 (2): 133-143.

A brief review is presented of studies on the relationships between dental caries and the fluorine content of public drinking water. Compiled data on findings in 7,257 school children, aged 12 to 14 years, show an increased incidence of *Lactobacillus acidophilus* counts of 30,000 or more with a decrease in the mean annual fluoride content of the public water supply.

Deane, Helen W., 1947. A CYTOCHEMICAL SURVEY OF THE PHOSPHATASES IN MAMMALIAN LIVER, PANCREAS, AND SALIVARY GLANDS. Amer. Jour. Anat., 80 (3): 321-360.

A histochemical study was made of the phosphatase distribution in the cells and stroma of the liver, pancreas, and salivary glands. The parotid study-tissue was secured from a rat, and the submaxillary gland slices were made from samples secured from two rhesus monkeys. Slides were prepared by the Gomori method, modified by Dempsey and Deane, and the gland sections were incubated with glycerophosphate, fructose diphosphate, yeast nucleic acid, and lecithin phosphate at pH's of 9.5, 7.0, and 5.0. Parotid sections were also incubated with glucose-1-phosphate at the same pH's.

Alkaline glycerophosphatase was distributed rather diffusely in the parenchymal cells of the parotid, in the endothelial linings of its smaller vessels (especially those capillaries in close proximity to the cells of the secretory ducts), and intensely in the secretory duct cells. Alkaline phosphatase appeared to have been limited to the smaller arteries and veins of the submaxillary gland. Neutral glycerophosphatase was generally precipitated in all of the tissue elements (nuclei being more reactive than the cytoplasm), but neither gland demonstrated acid-glycerophosphatase reactions.

The parotid displayed an alkaline glucose-1-phosphatase condition similar to but more intense in quality than its glycerophosphatase distribution, and with especially large precipitates occurring in the capillary and duct epithelia. Neutral glucose-1-phosphatase appeared in considerable concentrations throughout the gland cells, but was more intense in basophilic structures. No glucose-1-phosphatase reaction at pH 5.0 was revealed in either the parotid or the submaxillary gland.

Alkaline fructose diphosphatase, after 24 hours of section incubation, was found in the nuclei and cytoplasm of the cells of both glands,

and observations of lumen contents revealed the reactant to be present in intense quantities. The chemical was also found in the duct cells of the parotid, as well as in the blood vessels of both glands, though the substance was more evident in the capillaries of the parotid and in the artery and vein intimal layers of the submaxillary. Neutral fructose diphosphatase occurred in the capillary and duct walls of the parotid, and was demonstrated in the nuclei and endothelial cells of the submaxillary. Only the arteriole and venule walls of the submaxillary glands showed a reaction to the acid form of fructose diphosphatase.

Observations further showed that intense reactions of nucleic acid phosphatase (pH 9.5) occurred in the cells of the secretory duct of rat parotid, and was also present in the basophilic structures of the serous cells, while the submaxillary gland revealed this substance only in serous cells. Both organs displayed phosphatase in blood vessels, with the capillaries (those in close contact with the cells of the secretory duct) of the parotid, and the arteries and veins of the submaxillary giving the most intense vessel reactions. Neutral nucleic acid phosphatases occurred in the nuclei and cytoplasm of the duct cells of the rat, while reactions appeared to be rather diffusely distributed throughout the monkey's gland. Only the submaxillary, however, reacted to the walls and nuclei of the smaller arteries and veins.

Neither gland displayed any histochemical reactions to lecithin phosphatases.

The phosphatase contents of the salivary gland granulocytes is also described.

The above observations indicate that only alkaline phosphatases appear in the saliva, and that there are obvious species differences in the phosphatase content and distribution of the salivary glands.

Deederer, Carlton, 1948. DDT TOXICITY. Med. Rec., 161 (4): 216-220.

A review of DDT toxicity is presented which mentions xerostomia and dessicophobia among the symptoms of poisoning by DDT chemicals.

Delaunay, S., and Richard Jahiel, 1935. SUR LA PRESENCE DE POLYPEPTIDES, DANS LA SALIVE HUMAINE [The presence of polypeptides in human saliva]. Compt. rend. Soc. de Biol., 118 (14): 1418-1420.

The salivas of healthy persons were examined for polypeptide content; method is described in full. The polypeptide N ranged from 68 to 180 mg. per mille; amino acid N, from 102 to 182; and the index of cleavage, from 0.14 to 0.34.

Demel, Rudolf, 1926. DIE WECHSELBEZIEHUNGEN DES SPEICHELZUR MAGENPATHOLOGIE AUF GRUND VON TIEREXPERIMENTELLEN UND KLINISCHEN UNTERSUCHUNGEN [Interrelations between the saliva and gastric pathology on the basis of experimental investigations in animals and clinical observations]. Arch. klin. Chir., 143: 101-112.

Comparison was made in 5 intact dogs and in 15 dogs with salivary (sublingual, submaxillary, parotid) glands removed regarding the healing speed of gastric mucosa after excision of a 1.5 cm-long rectangular piece of the mucosa. Examination of the mucosa 8 and 14 days later showed almost complete healing in the intact dogs after

8 days, while a lentil-sized lesion was still present in the operated dogs after 14 days. In a further study the chemical composition of human saliva was determined in 20 normal subjects and in 20 subjects having peptic ulcers. Tests of salivary samples collected on 6 consecutive days before breakfast showed no significant differences with regard to the chloride content; salivary thiocyanate was markedly higher in ulcer patients (5.2 mg.%) than in the normal subjects (2.5 mg.%). The alkalinity was much higher and the diastatic power of the saliva much lower in the ulcer patients than in the healthy subjects.

Denisov, P. K., and P. S. Kupalov, 1933. VELICHINA USLOVNYKH REFLEKSOV SOBAKI V OSVESHCHENNOI I ZATEMNEENNOI KAMERAKH [The value of conditioned reflexes in the dog in a lighted and in a darkened room]. Arkh. biol. Nauk, Leningrad, 33 (5-6): 689-695.

Salivary reflex response to an electric-light stimulant acting in a dark and in a lighted room were compared. Several consecutive days of experimentation were conducted in each type of room. Results show that the conditioned reflex in response to light increases stepwise from one day to the next; it also increases after the change from the lighted room to the dark, and decreases after the reverse change. Conditioned responses to sound stimuli are stronger than to light, being strongest to a buzzer and then to a metronome; they increase invariably in the lighted room and decrease in the dark. The author suggests that the irritability-increasing influence of visual stimulations in the lighted room affects the auditory apparatus as well as the visual, but the adaptation to light moderates the intensity of visual stimulations. In the dark room the general irritability of the cortex is lowered, but adaptation to darkness increases the intensity of light stimulation. The presence of a determined number of indifferent stimuli affecting the animal in a lighted room constitute one of the factors increasing the irritability of the cerebral cortex, contributing to the animals well-being.

Dentay, J. T., and J. J. Rae, 1949. PHOSPHATASE IN SALIVA. Jour. dental Res., 28 (1): 68-71.

Studies were made to ascertain the existence of a salivary phosphatase and whether such a phosphatase is due to bacteria or to cellular debris, or both; methods are described in detail.

The phosphatase activity of resting saliva samples collected from 46 students was determined by the hydrolyzing action of saliva on an organic phosphate (disodium phenyl phosphate). The optimum pH for phosphatase action was found to be 5.1. At this point, 3.58 mg. phenol per 100 ml. fresh saliva were liberated from 0.05 M disodium phenyl phosphate at 37° C. in one hour and 1.17 mg. from boiled saliva.

Whole fresh saliva, filtered through a Seitz filter, showed no phosphatase activity. When pork kidney extract was similarly filtered, it passed through the filter unchanged. It was therefore assumed that saliva does not contain phosphatase naturally.

Since *Lactobacillus acidophilus* constitutes a large percentage of the oral flora, cultures of this organism were studied for phosphatase content; results were negligible. The author attributed the phosphatase in saliva to cellular debris and food residues, with lesser contribution by microorganisms.

It was suggested that the term "phosphatase in saliva" be used rather than "salivary phosphatase".

Desgrez, A., 1902. DE L'INFLUENCE DE LA CHOLINE SUR LES SECRETIONS GLANDULAIRES [On the influence of choline on glandular secretion]. *Compt. rend. de la Soc. de Biol. (Paris)*, 54 (24): 839-841.

Intravenous injections of choline in doses varying between 0.002 and 0.015 g. per kilogram of animal weight always increased salivary, pancreatic, biliary, and renal secretion.

Injection of choline into dogs and rabbits under chloralose anesthesia produced its effect in 1/2 to 1 minute. In the rabbit, choline-stimulated saliva was so abundant that it could cause asphyxiation. In the dog, submaxillary secretion increased from 1 drop each 3 to 4 minutes to 38 to 40 drops in the same time under the influence of a 0.019 per kg. dose. This stimulating effect, analogous to that of pilocarpine, was attributed to the trimethylamine group common to both substances.

Deutsch, W., and H. S. Raper, 1938. THE RESPIRATION AND METABOLISM OF SUBMAXILLARY GLAND TISSUE OF THE CAT. *Jour. Physiol.*, 92 (4): 439-458.

The submaxillary glands of cats were sectioned, and the respiratory and secretory activity of the tissue slices were studied under a variety of conditions. Acetylcholine bromide and eserine sulphate were used as secretory stimulants.

Glycolysis (which could be increased by the addition of glucose) occurred in the resting gland under anaerobic conditions, and the R. Q. of the resting gland varied from 0.59 to 0.8. During active secretion the R. Q. is similar to that of the resting-gland tissue, but can be increased to 1.0 by the addition of glucose. Evidence indicates that carbohydrate is not the sole substrate utilized by the glandular tissue, but glucose or fructose, if present, are used in preference to other possible materials.

Upon the addition of acetylcholine and eserine to the resting-gland tissue respiration is increased, and aerobic glycolysis occurs if glucose is present (this latter effect may be prolonged by ethylcarbylamine). Acetylcholine, in the proper amount, as well as allowing the tissue slices to remain in oxygenated Ringer's solution over a period of time, exhausts the gland of its normal substrate and respiration declines. This latter decline in respiration may be reversed (respiration increasing) by the addition of acetylcholine and glucose or fructose. The respiratory effects of acetylcholine are annulled by iodoacetate or fluoride.

Iodoacetate was demonstrated to produce a steady decline in the respiration of the resting gland tissue, and fluoride was found to have no effect on the process; both substances caused an initial increase in respiration in the presence of lactate.

Adrenalin promotes aerobic glycolysis when glucose is the substrate, and it is not annulled in its effect by atropine, as is acetylcholine.

Dewar, Margaret R., and G. J. Parfitt, 1954. AN INVESTIGATION OF THE PHYSICAL PROPERTIES OF SALIVA AND THEIR RELATIONSHIP TO THE MUCIN CONTENT. *Jour. Dental Res.*, 33 (5): 596-605.

A description and methods are given for quantitative determination of viscosity, flow elasticity, tackiness, spinnbarkeit (ability to be

drawn into an elastic thread), surface tension, specific gravity, and mucin content of saliva. Satisfactory measurement of the mucin content of the saliva was obtained by means of a tyrosine estimation method, and by a modified Congo red in acid alcohol (A.C.R.A.) test for unhydrolyzed mucin. In a study of salivary changes it is noted that 30% of salivary mucin is destroyed in 30 minutes standing at room temperature, 50% after 2 hours. Tests to inhibit mucinase activity showed 8 enzyme poisons (sodium azide, potassium cyanide, sodium arsenate, sodium fluoride, mercuric chloride, potassium iodide, iodoacetic acid, penicillin) to retard but not completely inhibit destruction of the mucin. Preliminary tests showed changes in the physical properties of saliva were found to occur before and after meals, in the same individual from day to day, and during the menstrual cycle in women. Paraffin-stimulated saliva was found to have a lower mucin content than non-stimulated "resting" saliva.

An analyses of data obtained from 700 samples of saliva, 1 hour after secretion, showed a correlation between the A.C.R.A. titer and both viscosity and spinnbarkeit; no relationship was found between tyrosine concentration and spinnbarkeit.

Dewar, Margaret R., and G. J. Parfitt, 1954a. MUCIN CONTENT, PHYSICAL PROPERTIES OF SALIVA AND CARIES ACTIVITY. *Jour. Dental Res.*, 33 (6): 751-756.

Measurements (Dewar, 1954m) were made of the mucin content, viscosity, ropiness, and tack of resting salivas from 140 individuals, aged 4 to 35 years; paraffin-stimulated saliva samples from these individuals were used to determine lactobacillus counts and buffer capacity. Clinical examinations, to assess the DMF dental score were used in conjunction with data from the stimulated saliva samples to determine caries activity.

No significant relationships were found between caries activity and either the salivary mucin content, or the various physical characteristics of saliva under study.

Diamond, Ben Elkan, 1950. A SELECTIVE MEDIUM FOR LACTOBACILLUS COUNTS FROM SALIVA. *Jour. dental Res.*, 29 (1): 8-13.

A selective medium for salivary lactobacillus counts is described, consisting of 1:10,000 sodium azide in Hadley's tomato agar.

Dietz, Anne K., 1939. THE CHEMOTACTIC INFLUENCE OF HUMAN SALIVA UPON LEUKOCYTES. *Jour. dental Res.*, 18 (4): 361-371.

Unstimulated, mixed saliva samples from three subjects were tested in vitro for ability to induce chemotactic movements in leukocytes; method is described in full.

Four hours after injecting approximately 300 cc. of 0.89% NaCl intraperitoneally into a rabbit, it was possible to withdraw a leukocyte-rich exudate from the peritoneal cavity. The exudate was used as a source of leukocytes. A drop of leukocytes suspended in exudate under a cover slip was brought in contact with saliva in a micropipette (50 μ diameter).

Camera-lucida drawings indicated that: In each case, the percentage of leukocytes attracted to the saliva significantly greater than the percentage attracted in the controls (centrifuged exudate). This positive chemotactic influence of saliva was not altered by centrifugation. Chemotaxis produced by untreated saliva is greater than

that produced by centrifuged or filtered saliva. Heating produced an insignificant difference; in saliva A, the chemotactic activity was reduced. The possibility that the attracting effect of the saliva was due to a difference in osmotic pressure between saliva and exudate was eliminated.

Dietz, Victor H., Ned B. Williams, and William E. Lawton, 1943. RELATIONSHIPS BETWEEN BLOOD AGGLUTININS FOR ORAL LACTOBACILLI, SALIVARY COUNTS, AND CARIES. Jour. Amer. dental Assoc., 30 (11): 838-841.

Paraffin-stimulated saliva was obtained from 15 caries-susceptible and 15 caries-immune individuals approximately 3 to 4 hours after breakfast. The saliva was diluted 1:20 and 1:200 with physiologic sodium chloride solution (pH 5.1), and incubated anaerobically at 37° C. for 72 hours, after which the colonies were estimated. Serum was obtained by centrifugation of from 3 to 5 cc. of blood and was diluted 1:10 with saline solution. Twelve strains of lactobacilli from the stock cultures were used in the agglutination reactions.

"In a comparison of the strength of the agglutinins for lactobacilli in the blood of fifteen highly caries susceptible and fifteen caries insusceptible patients, no significant differences could be demonstrated.

"It seems that, without exception, the highest titers are accompanied by a negative salivary lactobacillus count irrespective of the caries experience. The low agglutinin titers in the two groups were not consistently accompanied by high salivary counts.

"The high blood titers in our results appear to serve more directly as indicators of a low incidence of lactobacilli in the mouth rather than as an index of caries experience." (Authors' summary.)

Dionesov, S. M., 1931. DAL'NEISHIE MATERIALY K FIZIOLOGII SLIUNOOTDELENIYA [Further material on the physiology of salivary secretion.] Arkh. biol. Nauk, Leningrad, 31 (6): 517-527.

The influence of salivation rate on the amount of dry residue in submaxillary saliva was studied in a fistulated dog. Varying amounts of a food stimulant (dry black bread) were fed to the dog during 50 seconds at 30 minute intervals with or without subcutaneous injections of pituitrin. One-minute samples of saliva were collected during the 71 tests and determinations made of the amount, organic matter, dry residue and ash. Results show that decrease in food portion from 15 gm. to 7.5 gm. produced a 30% drop in salivation rate and a 6-7% decrease in salivary dry residue, mostly due to a drop in organic matter. Injection of pituitrin decreased the secretion rate up to 20% and increased the dry residue 5 to 10%; a control series substituting physiological solution for the pituitrin gave similar results to the non-injection series of tests. Excision of the superior cervical ganglion produced no decrease in the salivation rate while an increase in dry residue was noted in several tests. Subsequent administration of pituitrin again depressed the secretion rate, accompanied by a temporary drop in dry residue after the first feeding; the dry residue then increased to the pre-sympathectomy level. Injection of one cc. of 1:1000 adrenalin after the pituitrin eliminated the temporary drop in dry residue.

Dmitriev, I. G., and G. IA. Khvoles, 1928. K VOPROSU O VLIYANIY ERGOTAMINA NA SALIVATSIYU [On the influence of ergotamine on salivation]. Mediko-Biologicheskii Jour., 4 (2): 54-62.

A preliminary report is made of the influence of ergotamine on the activity of the salivary glands. Four dogs with submaxillary fistulae were kept under the same conditions of shelter and diet and starved 24 h. before the day of experimentation. Use was made of 20 gm. of meat as a salivary stimulant; the meat was eaten in 1 min. and the saliva collected in 3 min.; after 7 to 10 min. the feeding and collecting of saliva was resumed. The quantity and viscosity of saliva served as criterion for glandular activity, the viscosity being expressed in the number of drops per minute flowing through the capillary tube of Sahli's hemometer. Altogether 400 tests were made, up to 20 a day.

The experiments were divided in 4 groups.

1. Measurements in normal saliva showed that the average amount collected depends on the weight of the dog; for a dog weighing 14,300 gm. it varied from 0.7 cc. to 1.4 cc./3 min. on different days, on the same day, during up to 9 feedings, it varied not more than 0.1 to 0.2 cc. The fluctuations in viscosity were even greater, however the average figure remained rather constant: 11 drops/min. for a dog weighing 14,300 gr.

Control measurements after subcutaneous injection of atropine sulfate or 5 cc. pilocarpine were made. Injection of 0.3 to 0.5 cc. Gynergen "Sandoz" (containing 0.5 mg./cc. of ergotamine tartrate in solution) was then given. The usual salivary inhibition after atropine, and stimulation after pilocarpine was observed.

2. The 0.3 cc. dose of gynergen had practically no effect, those over 0.5 cc. produced abundant salivation without feeding, and temporary symptoms of toxicity. The results obtained after injection of 0.4 to 0.5 cc. are shown in 5 tables. A period of latency of 15 to 20 min. was observed after intramuscular, of 25 to 50 min. after subcutaneous injection. Then followed a decrease in pulse rate, and the salivary secretion [after feeding of 20 gm. of meat] became more fluid, as the number of drops/min. more than doubled. The amount of saliva remained in most cases near to normal, in a few cases spontaneous salivation set in.

3. In a subsequent series of experiments the same injections of gynergen were given, followed, after the typical effect had been obtained, by injections of atropine or adrenalin. 0.4 to 0.8 cc. of a 1:1000 solution of adrenalin in physiological solution was used, the doses for gynergen and atropine remaining as before.

Results show that 0.8 cc. of adrenaline paralyzed the action of 0.5 cc. gynergen [decrease in the amount of saliva, sharp increase in viscosity], while 0.4 cc. of adrenalin produced only a temporary inhibition; these two substances act, therefore, as antagonists; 4.5 cc. of atropine produced a saliva twice as fluid as that obtained after atropine alone; a certain antagonism exists, therefore, between these two substances also.

4. In a last series of experiments, both upper sympathetic ganglia were excised under general narcosis. After the dog's recovery, the double injections of gynergen and adrenalin or atropine were repeated; the results obtained coincided with those before the operation.

The author concludes that ergotamine acts on the salivary glands not only through the sympathetic

system, but also directly, in the same manner as adrenalin. The action through the chorda tympani is not excluded.

Dobbs, Edward C., 1932. LOCAL FACTORS IN DENTAL CARIES. *Jour. dent. Res.*, 12 (5): 853-864.

In a study of local factors affecting decalcification of dental enamel, dental plaque membranes were found to permit diffusion of 0.13 mg./day of Na_2HPO_4 through the membrane. Plaque density is considered to inhibit salivary dilution or neutralization of acids formed beneath the plaque.

Artificial plaques were produced in vitro over a 12-day period upon cleared, extracted teeth by alternate immersion in a saliva-bread crumb mixture for 8 hours followed by drying for 16 hours at body temperatures. This process accompanied by uncontrolled bacterial activity denatured the mucus from a viscous fluid to a firm gel.

A study of denaturation of acid-precipitated salivary mucin showed such mucin, dried on watch glasses for 24 hours to imbibe constantly decreasing amounts of distilled water, added for 15-minute periods. A constant absorption value, reached after 4 to 6 days, was only slightly changed by salt solution in concentrations present in saliva. The mucin became firm when bathed in Na_2HPO_4 , and to a lesser extent in either lactic acid, CaHPO_4 , or KCN . Lactic acid increased the absorption constant 5.88 percent compared with water; the three salts changed it less than one percent. Plaque material was found to contain 2.73 to 6.42 percent by weight of inorganic material; the organic portion contains from 27.62 to 52.17 percent mucin which is derived from saliva. Stimulated saliva was found to contain 0.10 to 0.37 mucin. Stimulated saliva, permitted to stand one hour, contains 1.54 to 4.62 percent by weight of flocculent material, composed principally of proteins plus oral and salivary debris. Salivary mucin participates in plaque formation by favoring food stasis, binding the mass closely to the teeth.

Dobbs, Edward C., 1932a. ROLE OF PLAQUES IN DENTAL CARIES. *Jour. dent. Res.*, 12 (3): 455.
Partial abstract of Dobbs 1932m.

Dodds, E. C., 1925. AN INVESTIGATION INTO THE AETIOLOGY OF DENTAL CARIES: V. THE CHEMICAL COMPOSITION OF SALIVA. *Brit. Jour. exper. Pathol.*, 6 (5): 266-268.

Chemical analyses of human saliva (by a modification of the method of Folin and Wu) and blood failed to show any significant relationship between the constituents of the two (except that blood values for nitrogenous bodies and for chlorides were consistently much lower than salivary values). Salivary constituents were so varied and fluctuated so greatly that no significance could be attached to them.

Dold, H., and Fr. Weigmann, 1934. ÜBER DIE WIRKUNG DES MENSCHLICHEN SPEICHEL AUF DIPHTHERIE-BACILLEN [On the action of human saliva on diphtheria bacilli]. *Zeitschr. f. Hyg. u. Infektionskrankh.*, 116 (2): 158-170.

Diphtheria bacilli introduced into the pharyngeal or nasal mucosa disappeared, followed by the appearance of diphtheroid and pseudo-diphtheric bacilli. It is presumed that a transformation takes place, the former (diphtheria bacilli to diphtheroid) being reversible. The authors assume

that this transformation is the function of the pharyngeal and nasal mucosa or of the saliva and nasal secretion, or both.

Human saliva was employed in the experimentation because of its availability. Experiments were first made to determine the bacteriostatic and bactericidal action of saliva. Approximately 20 trials were made, testing the action of saliva of four adults and three children (10-12 years of age) on diphtheria bacilli. Saliva, inactivated by heating at 56° C. for thirty minutes, allowed rich growths of diphtheria bacilli to develop. Fresh saliva had both a bacteriostatic and bactericidal effect and transformed diphtheria bacilli into diphtheroid and pseudo-diphtheric bacilli. The action of the fresh saliva of the 7 individuals on the diphtheria bacillus showed marked differences. An investigation of a large number of adults and children led to the assumption that there are individuals whose saliva possesses little, if any, of this action.

Diphtheria bacilli were cultured on nutrient previously determined free from diphtheric, pseudo-diphtheric, and xerose bacilli and the appearance of pseudo-diphtheric bacilli showed definitely that a transformation took place, and could be reversed within a certain time limit.

The authors conclude that the salivary action may be of greater importance in human diphtheria than the antitoxin content of the blood and of the tissues. (cf. Weigmann et al., 1937m.)

Dold, H., 1935. BEITRÄGE ZUR EPIDEMIOLOGIE DER DIPHTHERIE [Contributions to the epidemiology of diphtheria]. *Zentralbl. f. Bakteriol.*, (1) 135 (1-3): *69-*75, *200-*201.

The possibility was considered that the susceptibility of individuals to diphtheria bacilli could be based on a lack on diphtheria antitoxin in the individuals.

The author examined saliva for its effect upon these bacilli. Equal portions of fresh human saliva, mixed with equally large portions of virulent diphtheria bacilli strains, were kept at 37° C. for a certain time, and streaked onto plates. Controls were set up using similarly large portions of mixed saliva which had been heated at 56° C. for 30 minutes. A comparison of the cultures showed that fresh saliva inhibits diphtheria bacilli to various degrees and that it possesses the ability to transform genuine diphtheria bacilli into pseudo-diphtheria bacilli. Both of these reactions increase with the age of the individual.

Testing the action of saliva on diphtheria toxin, negative results made it appear that the diphtheria toxin was not noticeably affected by the saliva.

The diphtheria bacilli appeared to settle only in some damaged portion of the epithelium.

The author concludes that the occurrence of diphtheria is dependent upon four factors: 1) the presence of virulent diphtheria bacilli, 2) the properties of saliva and nasal secretion, 3) the condition of the mucous membrane, and 4) the antitoxin content of the individual.

The part of the diphtheria bacilli in the nose and pharynx is discussed.

Dold, H., W. Lächele, and Du Dscheng Hsing, 1936. ÜBER DIE EIGENSCHAFTEN, WIRKUNGSBREITE UND WIRKUNGSART DER ANTIBAKTERIELLEN HEMMUNGSTOFFE (INHIBINE) DES MENSCHLICHEN SPEICHEL [On the characteristics and the range and mode of action of the

antibacterial inhibitory substances (inhibines) of human saliva]. Zeitschr. f. Hyg. u. Infektionskrankh., 118 (4): 369-395.

An attempt was made to discern between the valid and non-valid experimental evidence on the inhibitory action of saliva on bacteria reported by previous authors.

Saliva (mouth fluid, not pure salivary secretion) was tested in regard to the nature of its inhibitory properties, the action of these properties on bacteria common to or introduced into the mouth, and resistance of the agents to heat, cold, storage, sunlight, and drying.

Theories attributing the inhibitory action to salt content, bacterial antagonism, lysozymes, etc., were examined. The action cannot be due to the salt content of the saliva since staphylococci, inhibited by fresh saliva-agar, grew abundantly on salt-agar plates. The inhibines cannot be identical with Fleming's lysozymes, since the lysozymes dissolve bacteria, while the inhibines have a bacteriostatic to bactericidal effect. Furthermore, the inhibines are non-filtrable, non-diffusible, not water-soluble, and cannot be precipitated by alcohol, acetone, or chloroform in contrast to lysozymes. Sunlight has no destructive action on lysozymes, while exposure of fresh saliva to sunlight for four hours destroys all inhibitory action. Lysozymes are unaffected by drying, whereas inhibines are highly sensitive to water loss. Lysozymes may have a slight effect on air-borne germs, while inhibines were shown effective on all test bacteria. The antibacterial inhibitory action of saliva does not rest in any great part upon bacterial antagonism although occasionally bacteria may contribute to it. Two series of agar plates were prepared, one inoculated with bacteria of salivary origin and the other containing fresh saliva. Both were seeded with *Bacillus prodigiosus* [*Serratia marcescens*]. Within 24 hours of incubation at 37° C., growth was good on the salivary bacteria-agar plates, while complete inhibition was seen on the fresh saliva plates.

The inhibitory action of saliva, although effective on 15 test bacteria, varied from organism to organism. The inhibines were found thermolabile, with total destruction of action occurring after heating for 1 min. at 100° C., 2 min. at 75° C., 3-5 min. at 56° C., or 30 min. at 52-54° C. Saliva inactivated by heating at 56° C. for 30 min. cannot be reactivated by addition of small amounts of fresh saliva.

Saliva refrigerated for 1-4 days, until frozen, was not inactivated.

Saliva stored for 10-15 days at room temperature completely lost all inhibitory action.

Dold, H., 1937. NEUE BEOBSACHTUNGEN ÜBER ANTI-BAKTERIELLE HEMMUNGSTOFFE (INHIBINE) UND ANTI-BAKTERIELLE WANLUNGSTOFFE (MUTINE) [New observations on antibacterial inhibitory substances (inhibines) and antibacterial transformative agents (mutines)]. Zentralbl. f. Bakteriologie, (1) 140 (3-8): *265-*267.

The antibacterial inhibitory action of saliva was tested by three methods, the putrefactive, the agar-mixture, and the "drop-on" method. Results of the tests agree and substantiate that (1) inhibines are not identical with lysozymes, and (2) that the inhibitory action does not rest on bacterial antagonism. Saliva, in saliva-agar cultures, possessed the ability to change genuine

diphtheria bacilli into pseudo-diphtheria bacilli. The transformative tendency of the host can be clearly seen in chromogenic bacteria (such as *Bacillus prodigiosus* [*Serratia marcescens*], *B. pyocyaneus* [*Pseudomonas aeruginosa*] and *Staphylococcus pyogenes aureus* [*Micrococcus pyogenes* var. a.]), which exhibited a difference in color between the raw-milk agar cultures and the 50% heated milk agar cultures.

Dold, H., 1938. ÜBER ANTIBAKTERIELLE EIGENSCHAFTEN TIERISCHER UND MENSCHLICHER SEKRETE (HAUTSEKRET, NASENSEKRET, BRONCHIALSEKRET, SPEICHEL, MILCH) UND PFLANZLICHER AUSSCHIEDUNGEN (HONIG, U.A.) [Antibacterial properties of animal and human secretions (dermal, nasal, and bronchial secretions, saliva, milk) and vegetal secretions (honey, etc.)]. Med. Klin., 34 (16): 546-550.

Hitherto unknown antibacterial substances have been found in secretions of the mucous membrane, in human and cow milk, in honey and in vegetables. Saliva has been found to inhibit growth and to alter certain properties of various bacteria. *Staphylococcus pyogenes aureus* [*Micrococcus pyogenes* var. aureus], streptococci, diphtheritic and pseudodiphtheritic bacteria, *B. coli* [*Escherichia c.*], *B. typhi* [*Salmonella typhosa*], *B. prodigiosus* [*Serratia marcescens*], *B. pyocyaneus* [*Pseudomonas aeruginosa*], *B. [acillus] subtilis*, *B. [acillus] anthracis*, *V. Metchnikoff* [*Vibrio metchnikovi*], *V. cholerae* [*Vibrio comma*], and acid-fast bacteria like *B. tuberculosis* [*Mycobacterium t.*] were seeded on saliva-agar medium made with either fresh or heated saliva. Growth was absent for all species except *B. coli* and *B. prodigiosus* which showed retarded growth. Fresh saliva, exposed to the air, putrefied after a much longer period of time than did heated saliva, indicating the antibacterial substance which affected the salivary and air-borne bacteria to be thermolabile. The inhibines acting against *B. tuberculosis* are more thermostable and hence possibly are of a somewhat different nature.

Dold, H., 1942. DIE BAKTERIEN-INHIBINWIRKUNG (BAKTERIOSTATISCHE WIRKUNG) STERILEN SUBMAXILLARISPEICHELDES HUNDES [The bacterial inhibine action (bacteriostatic action) of sterile submaxillary saliva of the dog]. Zeitschr. f. Hyg. u. Infektionskrankh., 124 (5): 519-530.

Submaxillary saliva, collected under sterile conditions from two dogs, was examined for bacteriostatic properties; the method is fully described. The saliva, shown to be bacteria-free, inhibited the growth of air-borne bacteria-*B. mycoides*, *B. [acillus] anthracis*, and *B. diphtheriae* [*Corynebacterium d.*]. The author concludes that naturally-occurring, bacteria-free saliva contains bacteriostatic agents which are effective against exogenous as well as endogenous organisms, and furthermore, that these findings may be applicable to man as well as to dog.

Dold, H., 1942a. DER BAKTERIEN-ANTAGONISTISCHE ANTEIL AN DER KEIMSCHÄDIGENDEN WIRKUNG DES SPEICHEL (DER MUNHÖHLENFLÜSSIGKEIT) [The antibacterial fraction of the antimicrobial action of saliva (the mouth cavity fluid)]. Zeitschr. f. Hyg. u. Infektionskrankh., 124 (5): 579-596.

A review of literature data on the antibacterial properties of saliva, from which the author concludes the following: Saliva contains certain properties which inhibit the reproduction of bacteria (inhibines), others which alter certain microbial characteristics (mutines), or remove

bacterial (phagocytic processes), or inhibit and destroy microbes (factors of cellular origin such as endolysins, leukins, or lysozyme). Inorganic substances (such as thiocyanogen salts) direct bacterial antagonism, and the nature of the food introduced into the oral cavity, may all contribute to this salivary phenomenon. 21 refs.

Dold, Hermann, 1943. DIE INHIBITION (KEIMVERMEHRUNGSHemmung) ALS ABWEHRMITTEL DER NORMALEN SCHLEIMHAUT GEGEN INFEKTION [Inhibition (bacteriostasis) as a defensive mechanism of the normal mucosa against infection]. Zeitschr. f. Hyg. u. Infektionskrankh., 124 (6): 597-605.

In vitro studies indicated the existence of antibacterial substances (inhibines) in the normal tracheal mucosa of rabbits. Excised, sterile tracheal tissues, living or dead, were inoculated in a like manner with like amounts of *Bacillus prodigiosus* and *B. anthracis*; after 1-3 days storage in damp chambers the bacterial growths were observed. Abundant growth of both organisms appeared on the devitalized tissues--as early as 24 hours after inoculation. On the living tissues, however, a definite antibacterial action was observed, persisting for 2-3 days, after which growth comparable to that occurring in the devitalized tissues was observed. From the foregoing, the author concludes that bacteriostatic agents (inhibines) exist in the tracheal mucosa which can be designated as constantly present and active *in vivo* (their disappearance in *in vitro* tests is attributed to the death of the tissues).

Domracheva, E.A., 1947. O VLIĖNIĖ SLĖNY NA ZHELUDOCHNUIU SEKRETSIU [On the influence of saliva on gastric secretion]. Trudy Kazan. Stomatol. Inst., Kazan', 1 (1947): 44-71. Abst.: Sovet. med. refer. Obozrenie, 1949 (3): 61-62.

The effect of saliva on canine gastric secretion was studied by introduction of the saliva through a gastric fistula into the isolated stomach of the dog. Samples of submaxillary saliva were collected from cats and dogs after chordal stimulation while parotid saliva was collected from fistulated dogs. The saliva, used either fresh or after 24 hours standing in the cold, was administered undiluted or as an alcoholic extract diluted with distilled water; water replaced the saliva in control tests. Fresh saliva stimulated an insignificant gastric secretion, one fifth of that elicited by water, while saliva chilled for 24 hours evoked more secretion than water. Oral administration of fresh saliva mixed with bread, milk, or meat inhibited gastric secretion, whereas the same food stimulants mixed with the chilled saliva increased gastric secretion.

Dorodnitsina, A. A., 1937. VLIĖNIE OKHLAZHDENIĖ I NAGREVANIĖ NA BEZUSLOVNYE SLĖNNYE REFLEKSY CHELOVEKA [The influence of cooling and heating on the unconditioned salivary reflexes in man]. Fiziol. Zhur. SSSR, 23 (1): 111-116.

The effect of large temperature changes on the salivary glands was studied in man; several tests were also made with simultaneous stimulation by 0.2% hydrochloric acid. Experiments were started at room temperature (17 to 23° C.); then the subject was transferred either to a room heated at 45 to 55°, to a refrigerator at 8°, or kept a while outdoors at a temperature of -3 to +3°. Respiration was through the nose. Salivary samples, collected every 5 minutes, were measured and examined for dry residue, organic and inorganic content,

viscosity (by the capillary method), and acid reaction (by Clark and Lebs).

Tabulated results show a definite rapid change in secretion under the influence of temperature. Cooling generally increases the secretion from both types of salivary glands, but more from the parotid, which results in an increase of the P/S coefficient. The rate of secretion increase after cooling corresponds to the data observed after ingestion of water by Biriukov (1934) and Krasnogorskiĭ (quoted by Biriukov), where the greatest amount of secretion was obtained after the use of cold water, especially of ice. The quantitative changes in secretion as well as alkaline reaction of saliva after cooling of the subject coincide with the changes obtained in the same patients by Norkina (1936), after pilocarpine injection. These facts may indicate a common functional channel for cold and pilocarpine to the salivary glands.

The quantitative changes obtained after heating were not uniform. Two groups of subjects were observed, those showing increased salivary secretion, and those showing decreased salivation.

The qualitative changes in the saliva correspond to the quantitative changes under the influence of heat or cold. Under the influence of heat, the percentage of dry residue decreases if the secretion decreases; it increases with an increased secretion. Under the influence of cold, the average amount of dry residue also increases, but this increase is predominantly due to its inorganic component which may become considerable; the increase in organic substance is insignificant.

A few tests, made under conditions of heating and simultaneous stimulation by 0.2% hydrochloric acid, showed that salivary secretion in response to the combined stimulation does not necessarily follow the same pattern: while the basic, heat-stimulated salivary secretion was decreased, it increased above normal during the [simultaneous] acid stimulation.

Concerning the influence of temperature on the viscosity of saliva, Gekker's findings (1930) were confirmed: the highest viscosity of saliva is produced during heating, the lowest during cooling.

Dorodnitsina, A. A., 1938. VLIĖNIE KOKAINIZATSII SLIZISTOI RTA NA BEZUSLOVNYE SLĖNNYE REFLEKSY U SOBAK [The influence of cocaine on the oral mucosa on unconditioned salivary reflexes in dogs]. Fiziol. Zhurn. SSSR, 25 (1-2): 127-131.

Unconditioned salivary reflexes, before and after cocaine of the oral mucosa, were studied in 5 dogs. Normal salivation was first measured (saliva collected in 1.5 min., measured 3 times), then the oral mucosa and tongue swabbed with a 2 to 10% cocaine solution during 3 min. After 5 to 10 min., when the cocaine-elicited salivation had ceased, a chemical stimulus was placed on the tongue: repellents - 0.5% HCl, 10% NaCl, 5% MgSO₄ - and foods - rusk powder, pulverized sugar, granulated sugar (dry), milk. Milk, and 5% MgSO₄ proved inadequate and were later rejected. The amount of saliva in 1.5 min. was measured three times and examined for its residue and viscosity.

Results proved that after cocaine of the oral mucosa in dogs, the reflexes to diversely tasting stimuli persist. After repelling substances, the total residue increased in parotid saliva 49 to 70%; in submaxillary saliva it decreased 5 to 22%. After food stimuli, the residue decreased 17% in parotid and 20 to 33% in submaxillary saliva. The viscosity of saliva in response to both food stimuli and repellents decreased 28 to 79% after

cocainization; the qualitative difference in the saliva had become obliterated.

The assumption that taste sensations and salivary reflexes are generated by separate elements has thus been confirmed.

Doubleday, A. W., 1909. PLODDINGS TOWARD DIAGNOSIS BY SALIVARY ANALYSIS. *Dental Cosmos*, 51 (4): 412-421.

The most abundant dialyzable salts found in the normal saliva are the chlorides of ammonium, potassium, and sodium, sulfate of potassium, carbonates of sodium and calcium, and the phosphate of calcium held in solution by CO₂. The parotid saliva is alkaline, and not viscid in man; submaxillary saliva is more alkaline, and more viscid as it contains mucin. Sublingual saliva is the most viscid and contains more salts than the submaxillary saliva. Under pathological conditions the saliva may contain many varieties of uric acid salts, urea, cholesterol, bile pigments, iodides, xanthin bodies, acetone, lactic acid (as lacto-phosphates), as well as sugar, lactose and glucose.

Doubleday, Arthur W., 1909a. MICROSCOPICAL OBSERVATIONS OF THE SALIVA. *Jour. of the allied [dental] Societies*, 4 (4): 243-253.

A general discussion of the biochemical properties of saliva and of its digestive functions. No experimental data.

Douglas, H. C., 1950. ON THE OCCURRENCE OF THE LACTATE FERMENTING ANAEROBE, *MICROCOCOCCUS LACTILYTICUS*, IN HUMAN SALIVA. *Jour. dental Res.*, 29 (3): 304-306.

Two to three ml. saliva samples, collected from each of 17 individuals, were plated on culture medium (pH 7.0); *Micrococcus lactilyticus* [*Veillonella gazogenes*] was present in all samples, in numbers from 3 million to 340 million per milliliter saliva. In several instances, the organism comprised 50% of the total salivary flora.

Doumer, E., 1922. LA CONSERVATION DE L'AMYLASE SALIVAIRE PAR LA GLYCERINE [The preservation of salivary amylase by glycerine]. *Compt. rend. de la Soc. de Biol. (Paris)*, 87 (27): 678-679.

Human saliva, diluted with equal amounts of distilled water and glycerine and preserved at regular room temperatures for more than 2 years, retained practically all of its amylolytic power.

Doumer, E., 1923. NOTE SUR LE POUVOIR AMYLOLYTIQUE MOLECULAIRE DE LA SALIVE [Note on the molecular amylolytic power of saliva]. *Compt. rend. de la Soc. de Biol. (Paris)*, 89 (25): 546-548.

Experiments concerning amylolysis by saliva were performed under aseptic conditions using 1 cc. of highly diluted "saliva" (1 to 10,000) per 25 cc. of a 4% starch solution incubated at 30°C. throughout the test.

Measurements of the amounts of maltose present at the end of 4 months and of 1 year were all found to be multiples of 3 mg. It is inferred that each 3 mg. of maltose are converted by one molecule of ptyalin and that the 1 cc. of

saliva used in the experiment contained around 60,000 molecules of ptyalin, weighing less than 0.000 083 mg.

Thus 1 molecule of ptyalin can decompose 3 mg. of starch, or 40,000 times the weight of the ptyalin.

Dreizen, Samuel, Arvin W. Mann, J. K. Cline, and Tom D. Spies, 1946. THE BUFFER CAPACITY OF SALIVA AS A MEASURE OF DENTAL CARIES ACTIVITY. *Jour. dental Res.*, 25 (4): 213-222.

One hundred and fifty-four samples of paraffin-stimulated saliva were collected from 50 patients who had been classified into three groups according to nutritional states and degrees of caries activity: (1) 16 persons nutritionally deficient but relatively caries-free; (2) 20 well-nourished persons with moderate caries activity; and (3) 14 well-nourished persons having rampant caries. The samples were examined for caries activity by three methods: (a) that of Fosdick, Hansen and Eppe (involving a chemical analysis for soluble calcium), (b) Hadley's method of *Lactobacillus acidophilus* counts per cc. of saliva, and (c) a new method based upon the buffer capacity of saliva, developed by the authors. In the third method, the buffering capacity of each saliva sample was determined by titration against lactic acid.

A good correlation existed among the results of the three tests for caries activity and the clinical findings.

The buffer capacity was expressed in cc. 0.1 N lactic acid. Group 1 had an average value of 0.615 (55.7% greater than that of the well-nourished patients of 2 and 3 combined); Group 2, an average capacity of 0.484; and Group 3, an average buffer capacity of 0.353.

When tested by the Fosdick method, 73.33% of the salivary samples for Group 1 and 15.12% of Group 2 and 3 combined were negative. A correlation between the chemical test and bacteriologic findings was noted; the Fosdick-negatives averaged 2,600 lactobacilli per cc. of saliva, while the positives averaged 24,600/cc.

The findings of the three tests were plotted for each of 149 saliva samples (irrespective of the nutritional status of the patients). 40 patients had a high buffer capacity and a low bacterial count (30 of them were Fosdick-negative, 6 doubtful, and 4 positive); 14 had a high bacterial count and a high buffer capacity (7 of them Fosdick-negative, 1 doubtful, 6 positive); 68 had a low buffer capacity and a high bacterial count (all Fosdick-positive); and 27, low buffer capacity and low bacterial count (26 Fosdick-positive).

When a comparison of buffer capacity was made with Fosdick's caries activity in 154 samples (irrespective of the groupings), an inverse correlation existed between the chemical activity and the buffer capacity.

The buffer capacity was compared with the change in pH during a 4-hour incubation period at 37°C. The largest drop, averaging 2.550 pH units, was seen in the samples with the highest positive Fosdick value; the smallest drop in pH occurred in the Fosdick-negatives, averaging 1.255 pH units. The trend followed by the intermediate positives and the doubtfuls was that, as the Fosdick value for caries activity increased, the pH drop increased, and the buffer

capacity was greatest where the drop in pH was smallest.

Dreizen, Samuel, Arvin W. Mann, Tom D. Spies, Bess C. Carson, and J. K. Cline, 1947. THE INFLUENCE OF SODIUM BISULPHITE ON ACID PRODUCTION IN SALIVA. Jour. dental Res., 26 (2): 93-97.

Paraffin-stimulated saliva samples (40 cc.), either untreated or treated with sodium bisulphite, were collected from 15 patients. Analyses for dental caries activity were made by the methods of Fosdick, Hansen, and Epple, [cf. Fosdick, 1937m], of Hadley [cf. Hadley, 1933m], and of Dreizen, Mann, Cline, and Spies [cf. Dreizen, 1946m].

When treated salivas were compared with untreated, no significant differences were observed in buffer capacity or in lactobacillus counts. There was, however, a striking reduction in acid production in all cases in which sodium bisulphite was used--either when added directly to the saliva sample (7.5 mg. added to 10 cc. saliva and incubated) or when incorporated in the paraffin block.

The authors indicated that sodium bisulphite apparently interferes with the enzyme or coenzyme systems of the degradation process of carbohydrates: the sulphite radical, in combination with the aldehyde formed, prevents lactic acid formation.

Dreizen, Samuel, and Tom D. Spies, 1947a. SOME OBSERVATIONS ON THE ASSOCIATION OF THE PRODUCTS OF PROTEIN PUTREFACTION WITH DENTAL CARIES ACTIVITY. Jour. dental Res., 26 (6): 409-419.

Paraffin-stimulated saliva samples of 51 persons were studied to determine the effect of indole and indole-3-acetic acid on acid production in saliva. The methods of Hadley [cf. Hadley, 1933m], of Dreizen [cf. Dreizen, 1946m], and of Fosdick, Hansen, and Epple [cf. Fosdick, 1937m], were used.

"1. Indole (7.5 or 10 mg.) or indole 3-acetic acid (10 mg.) partially or completely inhibited acid production in vitro in 10 cc. samples of saliva in 50 of the 51 patients studied.

"2. Indole inhibited the growth and acid production of the *Lactobacillus acidophilus* (Hadley) in yeast extract dextrose broth when added in a concentration of 6.0 mg. per 10 cc. in broth. When added in concentrations ranging from 2.5 to 5.0 mg. per 10 cc. of broth, it exerted a partial inhibitory effect on the growth and acid production of this organism.

"3. Indole-3-acetic acid partially inhibited the growth and acid production of the *Lactobacillus acidophilus* (Hadley) in yeast extract dextrose broth when added in concentrations ranging from 5.0 to 7.5 mg. per 10 cc. of broth.

"4. dl Tryptophane did not inhibit the growth and acid production of *Lactobacillus acidophilus* (Hadley) in any of the concentrations employed. In the presence of dl tryptophane, however, the inhibitory effect of indole was increased.

"5. Indole and indole-3-acetic acid, products of the bacterial decomposition of tissue proteins, in dilute solutions did not support the maximum growth of a strain of the oral

Lactobacillus acidophilus recovered from a carious lesion. This lends support to our working hypothesis that the products of protein putrefaction may to some extent be responsible for the decreased incidence of dental caries accompanied by extensive periodontal disease which is often seen in endemic pellagrins and persons with chronic vitamin B complex deficiencies." (Author's summary and conclusions.)

Dreizen, Samuel, Ann I. Reed, and Tom D. Spies, 1950. SALIVARY MUCIN AS A SOURCE OF ESSENTIAL AMINO ACIDS FOR THE LACTOBACILLUS ACIDOPHILUS (HADLEY). Jour. dental Res., 29 (6): 774-778.

Experiments were made to determine whether salivary mucin could replace tryptophane and/or casein hydrolysate in a synthetic medium as a source of nourishment for organisms retained in the dental plaque, and whether an exogenous source of proteolytic, mucolytic, and/or amylolytic enzyme is required for their growth.

Paraffin-stimulated, pooled, filtered saliva was added to 4 volumes of 95% ethyl alcohol. After standing in a covered vessel for at least 12 hours, the mixture was filtered and the precipitate washed with 95% ethyl alcohol and ether. The mucin was recovered and, after drying, was ground into a fine powder.

The test medium of Landy and Dicken was modified for each of three assays. In Assay 1, the tryptophane of the medium was replaced by an equal amount by weight of salivary mucin (2 mg. per tube) and/or 1 mg. each of proteolytic, mucolytic, and amylolytic enzymes in various combinations; in Assay 2, the casein hydrolysate was replaced by salivary mucin in an equal amount (50 mg. per tube) with and without the enzymes; and in Assay 3, both tryptophane and casein hydrolysate were replaced by an equal amount by weight of mucin (52 mg.) and by the various enzymes. (Method of assay is described in full.)

The Hadley strain of *Lactobacillus acidophilus* (ATCC #4646), obtained from a carious lesion, was used in the tests. One drop of inoculum was added to each tube in each assay (set up in duplicate) after autoclaving, cooling, and addition of the enzymes. Controls consisted of unmodified Landy and Dicken medium. After a 72-hour incubation period at 37°C., the cultures were centrifuged and growth was read of the packed cell volume. Acid production was determined by titration.

The following conclusions were drawn from the results of the experiments: When tryptophane and/or casein hydrolysate in the Landy and Dicken medium (which is nutritionally adequate for the maximum growth of the Handley strain of oral *L. acidophilus*) is replaced by precipitated salivary mucin, the medium is inadequate nutritionally for *L. acidophilus*. When crystalline trypsin and/or amylase are added to the test medium in the assays, the value of precipitated salivary mucin as a source of essential amino acids is enhanced.

Precipitated salivary mucin may serve as the source of essential amino acids for *L. acidophilus* in the presence of an exogenous source of proteolytic or amylolytic enzymes capable of hydrolyzing the glycoprotein.

Dreizen, Samuel, William Niedermeier, Ann I. Reed, and Tom D. Spies, 1952. THE EFFECT OF ACTH AND CORTISONE ON THE SODIUM AND POTASSIUM LEVELS

OF HUMAN SALIVA. Jour. dental Res., 31 (2): 271-280.

"1. The repeated intramuscular injection of pituitary ACTH or synthetic cortisone is followed by definite changes in the concentration of sodium in the human saliva. The sodium level of resting and stimulated saliva declined within 4 hours after the beginning of injections in each of the 5 subjects.

"2. The potassium concentration of the saliva was not materially altered following the injection of either of these hormones in any of the subjects with the result that there was a decrease in the sodium/potassium ratio. The decrease of the sodium/potassium ratio was greater in the samples of resting salivas as contrasted with the samples of stimulated saliva. This difference appears related to the difference in the rate of flow.

"3. The potassium content greatly exceeded the sodium content in the samples of saliva before, during and after treatment with either ACTH or synthetic cortisone acetate.... In every patient the potassium content of the saliva exceeded the normal blood serum or plasma value for this element. In contrast, the blood sodium content in each patient was approximately 3 to 15 times as great as the sodium concentration of the saliva.

"4. The present studies show that saliva is not an ultrafiltrate of the blood. The secretory cells of the human salivary glands possess the faculty of selecting and concentrating certain blood constituents in their elaboration of saliva, a process which is under hormonal as well as neural control." (Authors' summary and conclusions.)

Dreizen, Samuel, Henry A. Spies, Jr., and Tom D. Spies, 1952a. THE COPPER AND COBALT LEVELS OF HUMAN SALIVA AND DENTAL CARIES ACTIVITY. Jour. dental Res., 31 (1): 137-142.

Qualitative and quantitative analyses of paraffin-stimulated saliva samples from 14 subjects were made for trace elements (copper, cobalt, nickel, and molybdenum). Their effect on acid production and on *Lactobacillus acidophilus* count was observed. All 48 saliva samples contained copper, suggesting it to be a normal salivary constituent; none contained any detectable amount of nickel nor molybdenum; 10 of 37 samples tested showed traces of cobalt. When examined quantitatively, the copper concentration (10.00 to 47.50 mg./100 cc. saliva) greatly exceeded that of the cobalt (12.53 mg., maximum concentration).

In vitro studies failed to demonstrate any influence exerted by copper or cobalt on dental caries activity (taking their effect on pH and on *L. acidophilus* numbers as indicators).

Dreizen, Samuel, A. I. Reed, W. Niedermeier, and T. D. Spies, 1953. SODIUM AND POTASSIUM AS CONSTITUENTS OF HUMAN SALIVARY BUFFERS. Jour. dent. Res., 32 (4): 497-503.

A study of the paraffin-stimulated saliva of 80 patients indicated that the buffer capacity of the saliva was directly related to the rate of flow and a similar relationship was noted for the mean sodium content of the saliva samples. In contrast, the mean concentrations of potassium were of the same magnitude regardless of the volume or buffer capacity.

A study of unstimulated and paraffin-stimulated saliva of 25 additional patients indicated that the buffer capacity and the bicarbonate and sodium concentrations of samples of the stimulated saliva exceeded those of resting saliva in each case. The differences between the potassium concentration of the two types of saliva were not great and the phosphate and protein content of unstimulated saliva exceeded that of the stimulated saliva in a great majority of the cases.

It is suggested that the increase in the buffer power of stimulated saliva is due to the increased elaboration of sodium and bicarbonate by the salivary glands in response to stimulation.

Dreizen, Samuel, J. J. Mosny, O. R. Paddor, and T. D. Spies, 1956. IN VITRO STUDIES ON THE PROTECTION OF PENICILLIN-SENSITIVE ORAL ACIDOGENIC BACTERIA BY YEASTS PRESENT IN HUMAN SALIVA. Jour. Dental Res., 35 (2): 249-254.

Pure 24-hour thioglycollate broth cultures of *Lactobacillus acidophilus*, *Streptococcus salivarius*, *Staphylococcus albus* [*Micrococcus pyogenes* var. a.], *Candida albicans*, and *Saccharomyces cerevisiae*, previously unexposed to penicillin, were incubated at 37°C. for 72 hours in synthetic media containing graded amounts of penicillin-C-potassium ranging from 1 µg. to 25 mg./tube. Turbidimetric examination showed the minimum concentration of the penicillin completely inhibiting growth of the test organism in pure culture to be: *L. acidophilus*, 7.5 µg. in double-strength Landy and Dicken broth (Jour. Lab. clin. Med., 27: 1086, 1942) and 10 µg. in thioglycollate broth; *Staph. albus*, 2.5 µg. in each medium; *Str. salivarius*, 7.5 µg. in Landy and Dicken broth, and 25 µg. in thioglycollate broth. The yeasts were not inhibited in either broth by any of the test concentrations of the penicillin. Mixed cultures of the acidogenic strains were then cultured in similar fashion with either of the yeasts in the synthetic media containing penicillin. Strain mixtures containing a yeast plus all 3 bacteria, *L. acidophilus* and *Staph. albus*, *L. acidophilus* and *Str. salivarius* or *L. acidophilus* grew at all penicillin concentrations.

Mixtures of the three bacteria in the absence of a yeast showed partial inhibition but were more resistant to penicillin in each medium than were combinations of *L. acidophilus* and either *Staph. albus* or *Str. salivarius*. Tests of acid-production by the test strains showed this to be either reduced to negligible amounts or completely prevented by amounts of penicillin far below those which failed to produce a complete bactericidal effect in strain mixtures. Bio-assay of control or inoculated media showed no noteworthy reduction of penicillin concentration.

Dreizen, S., E. J. Gilley, and T. D. Spies, 1956a. A COMPARISON OF THE PREVAILING CELL TYPES IN SALIVA OF PERSONS WITH AND WITHOUT PERIODONTAL DISEASE. Oral Surg. Oral Med. Oral Pathol., 9 (3): 278-283.

Comparison of samples of resting saliva from 40 patients having active periodontal disease and 46 subjects free of such disease showed samples from the periodontal patients to have substantially greater numbers of bacteria-covered epithelial cells, as well as greater numbers of epithelial cells and leukocytes, and greater incidence of their degenerated forms. The morphology of cellular elements in the salivas of

the periodontal and periodontal-free subjects respectively resembled those reported as characteristic for the salivas of caries-immune and caries-susceptible persons.

Dreizen, S., W. Niedermeier, J. G. Dreizen, and T. D. Spies, 1958. EFFECT OF DELETION OF BIVALENT TRACE MINERALS ON GROWTH AND GLYCOLYTIC ACTIVITY OF ORAL ACIDOGENIC MICROORGANISMS. Jour. dent. Res., 37 (6): 1149-1156.

The effect of removal of naturally-occurring trace elements in human saliva on growth and glycolytic activity of oral flora was studied by addition of an organic chelating compound to saliva-glucose mixtures or to bacteriologic media. The chelators included oxine, sodium diethyldithiocarbamate, nitroso-R-salt, titan yellow, and thiourea. Results showed a 0.0005 M concentration of oxine to completely inhibit acid production in 21 of 30 test mixtures, composed of 10 ml. aliquots of paraffin-stimulated saliva from caries-active subjects and 100 mg. each of glucose and tricalcium phosphate, after 4 hours incubation at 37°C.; a 0.001 M concentration of oxine completely inhibited glycolysis in 22 and partially inhibited in 3 of 25 similar tests. A 0.001 M concentration of sodium diethyldithiocarbamate completely inhibited acid production in 4 samples and showed partial inhibition in 13 of 18 salivary-glucose samples; at a 0.0005 M concentration corresponding results were respectively 3, 12, and 3, of 18 samples tested. Other chelators were ineffective in inhibiting glycolysis. Further tests with oxine added to saliva-glucose and to bacteriologic media showed the supplementary addition of $MnCl_2$ to partially or completely reverse the glycolysis-inhibition effected by oxine. The findings suggest that chelation of Mn^{++} in the saliva produces the inhibition. Determination of the manganese content of paraffin-stimulated human whole saliva showed the Mn content to range from 0.0011 to 0.017 $\mu g/ml.$ with a mean of 0.005 $\mu g.$

Dudley, Sheldon F., 1924. SOME FUNDAMENTAL FACTORS CONCERNED IN THE SPREAD OF INFECTIOUS DISEASE. lancet (London), 206 (5258): 1141-1146.

A discussion is presented on some of the factors involved in the spread of infectious diseases, including droplet infection as a means of microbial dissemination, host resistance, and variations in parasitic virulence. Droplets of saliva or mucous carrying bacteria may travel for great distances. However, infection usually takes place only at short distances since at greater distances the infected droplets are in very low concentration. The number of bacteria in these droplets and the exposure time are also considered important factors in droplet infection.

Dudorova, A. A., 1948. VLIYANIE SIL'NYKH RAZDRAZHITELEY AMPULY PRIAMO KISHKI NA SEKRETSIU SLIUNNYKH ZHELEZ [The influence of strong stimulation of the rectal ampulla on salivary secretion]. Sbornik Trudov Ivanov. Sel'skokhoz. Instit. Kafedra normal'. i patol. Fiziol., 10 (2): 19-32. Abst.: Sovet. med. refer. Obozrenie, Fiziol., 1952 (9): 87.

Study was made of the influence of strong rectal stimulation on the inactive salivary gland and on either reflex, spontaneous, morphine, or pilocarpine salivation in dogs having fistulae of the submaxillary and parotid glands. Dilation of the rectal ampulla was produced by a rubber balloon filled with a determined volume of air; spasmodic contraction of smooth musculature of the rectum was induced by faradic stimulation of the rectal mucosa.

Experimental results show that the mucosa of the rectal ampulla is a receptive field from which impulses are transmitted to the salivary glands, influencing their activity. A strong stimulation of the rectal ampulla produces a prolonged stimulation of the salivary center, manifesting in spontaneous salivation, the intensity of which is directly proportioned to the strength of stimulation. Interoceptive stimulations produce greater changes in the activity of the salivary glands than strong exteroceptive stimulations. Stimulation of the rectal ampulla depresses the reflex salivary secretion and sharply influences the rate and character of morphine or of pilocarpine salivation.

Duffy, Carl E., Paul V. Woolley, and Wilfred S. Nolting, 1947. RABIES. A CASE REPORT WITH NOTES ON THE ISOLATION OF THE VIRUS FROM SALIVA. Jour. Pediat., 31 (4): 440-447.

The case history of a 13 months old boy showing symptoms of a central nervous system disease, is presented in which the clinical diagnosis was undecided. The saliva, recovered from the infant while under paraldehyde sedation, was intracerebrally injected raw and treated (with penicillin) into mice. The untreated salivary samples caused death of the animals within 24 hours, but the treated samples allowed the mice to survive long enough to permit recovery of the rabies virus, as well as identification by histological methods (Negri bodies present) and neutralization tests (using hyperimmune rabies antiserum). No autopsy was performed to further verify the post-mortem laboratory findings.

Duguid, J. P., 1945. THE NUMBERS AND THE SITES OF ORIGIN OF THE DROPLETS EXPELLED DURING EXPIRATORY ACTIVITIES. Edinburgh Med. Jour., 52 (11): 385-401.

An extensive study of the numbers and origin of bacteria-bearing droplets expelled during expiratory activities (i.e., coughing, sneezing, talking, and laughing). Droplets were estimated by four methods (described in detail). Cultures of *B. prodigiosus* [*Serratia marcescens*] were inoculated at various sites as indicators and the number of droplets expelled from nose and throat during expiratory activities was estimated.

The numbers of expelled droplets larger than about 20 μ in diameter, revealed by colony counts of 12 sq. in. blood agar plates exposed 3 in. in front of the mouth (15-45 tests in each case), was as follows (average numbers in parentheses): mouth breathing, 1 minute, 0-0 (0); laughing loudly, 1 minute, 0-6 (1); speaking loudly 100 ("K's"), 0-650 (76); counting softly from 1 to 100, 0-30 (8); counting loudly from 1 to 100, 1-284 (110); a throat cough, 0-1100 (48); lip cough, 15-1344 (490); and tongue-teeth cough, 21-6500 (1400). In strong nasal expiration

numbers ranged from 0 to 1200 (280), and in sneeze with mouth masked, 3-185 (28).

The numbers of expelled droplets larger than about 20μ in diameter, computed from counts of stain-marks on slides exposed 6 in. in front of the mouth (12 tests in each case), were as follows: counting loudly 1 to 100, 40-550 (260); throat cough, 0-1,100 (120); lip cough, 360-5,800 (2,000); tongue-teeth cough, 30,7,100 (1,800); natural sneeze 3,700-46,000 (24,000); simulated sneeze (weak), 5,000-52,000 (26,000).

Numbers of bacteria-carrying droplets initially smaller than about 100μ in diameter, computed from colony counts of blood agar plates exposed in the slit sampler [cf. Bourdillon, 1941n] between 1/2 and 1-1/2 minutes after droplet-spray production, were as follows (9-23 tests in each case): strong nasal expiration, 0.65 (16); speaking loudly 100 "K's", 0.30 (7); counting softly from 1 to 100, 0-35 (13); counting loudly from 1 to 100, 5-210 (71); throat cough, 0-80 (8); lip cough, 5-3500 (720); tongue-teeth cough, 80-1500 (730); natural sneeze, 4,500-150,000 (39,000); and simulated sneeze (strong), 120,000-1,000,000 (310,000).

Numbers of expelled droplets with initial diameters between about 1 and 100μ , computed from counts of stain-containing droplet nuclei on oiled slides exposed in the slit sampler between 1/2 and 1-1/2 minutes after droplets-spray production (16-20 tests in each case), were as follows: counting softly from 1 to 100, 0-160 (63); counting loudly from 1 to 100, 50-770 (250); lip cough, 490-16,000 (4,800); tongue teeth cough, 1,500-52,000 (8,200); natural sneeze, 65,000-1,100,000 (1,100,000); and simulated sneeze (strong), 1,500,000-30,000,000 (9,300,000).

The numbers of expelled droplets larger than about 20μ in diameter originating from the throat, as revealed by counts of B. prodigiosus colonies on 12 sq. in. plates exposed 3 in. in front of the mouth and nose (15-30 tests in each case), were as follows: From the throat, laughing loudly, 1 minute, 0-12 (2); speaking loudly 100 "K's", 0-1100 (92); throat cough, 0-279 (31); and natural sneeze, 0-2300 (360). From the nose, numbers ranged as follows: nose breathing, 5 minutes, 0-6 (2), and natural sneeze, 0-5600 (250).

The numbers of expelled droplets initially smaller than about 100μ in diameter, as computed from counts of B. prodigiosus colonies on plates exposed in the slit sampler between 1/2 and 1-1/2 minutes after droplet spray production (10 tests in each case), were as follows: speaking loudly 100 "K's", 0-33 (7); throat cough, 2-5.3 (2); and natural sneeze, 0-390 (110). From the nose, comparable values were: nose breathing, 5 minutes, 0.5 (2) and natural sneeze, 5-360 (56).

Dunlop, Gavin A., 1933. THE DIASTATIC INDEX IN ACUTE PAROTITIS. *Lancet* (London), 225 (5734): 183-184.

A study of 60 cases of acute parotitis indicated that there is an increase in urinary diastase which is found from the second day of the disease and may continue after swelling of the glands has subsided. All diastase readings of mumps cases were well above 30 Wohlegemuth units per cc. and some were over 200 units. It

is suggested that the diastase is derived from the parotid glands themselves.

Dupouy, R., 1904. SUR LA PRÉTENDUE EXISTENCE DE L'EAU OXYGÉNÉE DANS LA SALIVE [On the alleged existence of hydrogen peroxide in saliva]. *Compt. rend. de la Soc. de Biol. (Paris)*, 56 (6): 260-261.

The presence of hydrogen peroxide was not detected in saliva using a guaiacol test. This test is very sensitive: if a very small amount of H_2O_2 is added to saliva, an indirect oxidizing enzyme breaks it down and liberates active O which produces the color reaction of the guaiacol test.

Duyvensz, Frans, 1934. THE SALIVA. *Proc. roy. Soc. Med.*, 27 (12): 1583-1600; discussion 1600-1604.

A review is presented of salivary studies by the author and by other investigators which discusses sampling methods, chemical constitution, and the correlation of salivary composition with various states of health. Hypophyseal hormones in saliva pH, calcium and sulfocyanate in saliva are discussed in detail.

In an investigation of the saliva of pregnant women, 6 cc. of such saliva injected into an infantile mouse, over a three day period, caused ovarian and other changes which were observable on postmortem examination of the mouse 4 to 6 days later. The sulfocyanate content of saliva was found to vary normally from an average of 0.05 to 0.17 mg./cc. at different times of the day. Changes in sulfocyanate levels are correlated with changes in blood pressure, in capillary permeability, and in secretion of serum calcium in cases of pyorrhea alveolaris.

In the discussion, F. W. Broderick indicated that ingestion of massive doses of alkali raised salivary pH from 6.4-6.8 to 7.4, while raising the blood alkali reserve from 24.22 to 27.68 millimoles. This procedure produced clinical symptoms of acute alkalosis, followed by acute dehydration and the appearance of acidosis when the salivary pH dropped to 5.6-5.8, the alkali reserve dropped to 23.8.

Dzhavhrishnili, T. D., 1955. BEZUSLOVNYE I USLOVNYE SLIUNNYE REFLEKSY PRI RAZDRAZHENII ZUBA [Unconditioned and conditioned salivary reflexes after dental stimulation]. *Soobshcheniia Akad. Nauk Grusin. SSR*, 16 (2): 139-146. *Abst.: Sovet. med. refer. Obozrenie*, 1955 (7): 6.

The effect of thermal or faradic stimulation of the teeth on unconditioned and conditioned salivary reflexes were studied in 3 dogs having fistulated parotid glands. The stimulation was administered by two types of electrodes fixed in the lower canine teeth with phosphate cement. The minimal power required to stimulate salivation was determined after 2 to 3 days of testing. Painful dental stimulation was found to elicit saliva primarily from the gland ipsilateral to the stimulation, possibly due to a peculiarity of the unconditioned salivary reflex arc. The establishment of a conditioned reflex on the basis of dental stimulation as the unconditioned stimulus proceeds in the same manner as with other oral unconditioned stimuli.

Eddy, Nathan B., 1929. THE REGULATION OF RESPIRATION. XXVII. THE EFFECT UPON SALIVARY SECRETION OF VARYING THE CARBON DIOXIDE AND

OXYGEN CONTENT OF THE INSPIRED AIR. Amer. Jour. Physiol., 88 (3): 534-545.

120 observations were made on 17 large dogs anesthetized by subcutaneous injection of morphine and urethane. Salivary secretion (right submaxillary duct), blood pressure, and respiration were recorded while the animals breathed various gas mixtures by tracheal cannula.

"1. When the submaxillary gland of the dog was made to secrete at a constant rate by continuous intravenous administration of pilocarpine (1:100,000), an increase of the carbon dioxide in the inspired air increased the rate of secretion; a decrease of the oxygen in the inspired air decreased the rate of secretion.

"2. The increase in the rate of secretion was obtained when there was 1 percent of carbon dioxide in the inspired air. It was greater with higher percentages of carbon dioxide (to 10 percent). It was greater the more prolonged the period of administration.

"3. Following the administration of carbon dioxide when the animal was breathing room air again the secretion rate usually fell below that before the carbon dioxide was given and recovered very gradually if at all. This after-effect was more marked with the higher percentages of carbon dioxide or with prolonged administration.

"4. The decrease in rate of secretion was obtained when there was 18 percent of oxygen in the inspired air. It was greater with lower percentages of oxygen (to 7 percent). Following the administration of low oxygen when the animal was breathing room air again the secretion rate usually recovered promptly and not infrequently increased above that before the low oxygen was administered.

"5. If the administration of low oxygen (7 percent) was prolonged the secretion rate began to increase while the low oxygen inhalation continued. In some cases this increase brought the secretion rate very much above that before the low oxygen was started.

"6. The effects of high carbon dioxide and of low oxygen were obtained with both chorda tympani and vago-sympathetic cut. They appeared to be obtained independently of the effect upon the blood pressure of the artificial gas mixture administered and of the level of the blood pressure at the time of administration, except that during low oxygen inhalation the secondary increase in secretion rate and a fall in the blood pressure began at about the same time.

"7. The volume flow of blood from the submaxillary gland was increased both by increasing the carbon dioxide and by decreasing the oxygen in the inspired air." (Author's summary and conclusions.)

Eddy, Walter H., Hattie L. Heft, Samuel Rosenstock, and Ruth Ralston, 1933. EFFECTS OF DIET ON SALIVARY PHOSPHATE. Jour. dental Res., 13 (6): 511-519.

"The chemical law of mass action, and the fact that tooth enamel is composed of $\text{Ca}_3(\text{PO}_4)_2$, suggest that the solution equation-- $\text{Ca}_3(\text{PO}_4)_2 \rightarrow \text{Ca} + \text{PO}_4$ --can be arrested by surrounding the tooth with a medium (e.g., saliva) rich in PO_4 ions, as suggested by Klein, Kruse, and McCollum. It is probable, as suggested by previous observers, that if this is the mechanism, or one of the mechanisms by which caries

is controlled, it cannot be continuously operative, for in that case a person with permanently low salivary phosphate would have severely eroded teeth.

"Our tests indicate that it is possible, by dietary means, temporarily to reduce salivary P and, during this period, to provide thereby conditions favorable to solution of enamel. They indicate that salivary P is (a) lowered by rapid ingestion of sugar, or of less readily digested carbohydrate, or of protein food; (b) unaffected by ingestion of fats; and (c) increased by ingestion of inorganic phosphate.

"The foregoing data indicate that temporary changes in salivary P of considerable magnitude are producible by changes in diet. The data are not offered as proof that the defensive mechanism postulated by Klein, Kruse, and McCollum is a factor in caries prevention. In fact, the role of P intake as affecting caries prevention has been recently challenged by Shelling and Asher. The conditions necessary for enamel solution have been lately reported by Forbes, who has indicated that the composition of fluid surrounding a tooth can influence enamel solution. In the mouth the environmental fluid is saliva, and our studies indicate, in accord with the findings of others, that diet can influence the composition of this secretion." (Author's summary.)

Edington, I. C., 1901. SECRETIONS OF THE MOUTH DURING PREGNANCY. Dental Cosmos, 43 (8): 922-925.

Pregnancy is not considered a direct cause of an acid condition of saliva.

Edmonds, E. J., R. W. Bell, Jr., and E. Beerstecher, Jr., 1957. SALIVARY TRYPTOPHAN AND ITS RELATION TO DMF. Jour. dent. Res., 36 (6): 839-842.

Description is given of the microbiologic assay of salivary tryptophan, using Leuconostoc mesenteroides in a chemically defined medium. Tests of unstimulated samples of whole saliva, collected from each of 100 dental students 2 hours after a meal, showed the amount of free tryptophan to range from 0 to 2.1 $\mu\text{g}/\text{ml}$. of saliva. Duplicate assays on the same saliva sample showed about twice the amount of tryptophan measured by Leuconostoc mesenteroides to be measured by Lactobacillus plantarum; the increased amount agreeing with previous assays (Kirch, et. al., 1947), is attributed to the presence in saliva of indole and its derivations which can be utilized by L. plantarum in addition to tryptophan. No statistical relationship was found between salivary tryptophan levels and DMF scores of test subjects.

Effront, Jean, 1922. INFLUENCE DE LA FILTRATION SUR LES AMYLASES [The effect of filtration on amylases]. Compt. rend. de la Soc. de Biol. (Paris), 86 (5): 271-273.

Experiments on filtration, with and without heating, of saliva and other liquids containing amylase showed that filter paper adsorbed ptyalin and did not release it to any great extent except in a 1% starch or NaCl solution. The adsorption of the diastase increased from 60% to 20°C to 96% at 65°C.

Effront, Jean, 1922a. SUR LES PROPRIÉTÉS DISTINCTIVES DES AMYLASES DE DIFFÉRENTES PROVENANCES [On the distinctive characteristics of amylases from different sources]. *Compt. rend. de la Soc. de Biol. (Paris)*, 86 (5): 274-275.

Amylases from various sources, including saliva, were compared as to solubility in water, optimum temperature, difference between liquifying and saccharifying powers, thermostability, and degree of resistance to lactic acid action.

Saliva contains a water-soluble diastase with an optimum temperature of 40°C. The diastase has high starch-liquifying and low saccharifying power. It does not survive heating at 75°C for 15 minutes, but is resistant to the effects of lactic acid.

Efimov, V. V., B. V. Tolokonnikov and V. A. Gamburtsev, 1942. K VOPROSU OB IZMENENIIĖKH FIZIKO-KHIMICHESKIKH I BIOLOGICHESKIKH SVOISTV SLIUNY U LETCHIKOV PRI UKACHIVANII, VRASHCHENII I KISLORODNOM GOLODE [On the changes of physico-chemical and biological properties of saliva in pilots during sea-sickness, gyration and air hunger]. *Biull. Eksper. Biol. i Med.*, 13 (5-6): 44-47.

The author made a study of the changes in salivary surface tension in relation to air and to benzol during sea-sickness, gyration and hypoxemia.

The saliva of 60 men of different age and size was examined. The first salivary sample was taken 2 h. after breakfast and a period of rest, the second sample after 15 min. of swinging (on swings used for the testing of pilots) or gyration and tumbling about in Baroni chairs. The surface tension of the salivas measured by means of Reh binder's apparatus at 18°C. The experimental cases were divided into four groups: (1). those who showed no physiological reactions or hardly any; (4). those who vomited or stopped the experiment after 2 min. because of nausea; and (2 & 3), those who, without vomiting, experienced, to a greater or lesser extent, a drop in pulse rate and in blood pressure.

The tabulated results showed that only the figures of surface tension in relation to benzol mark a correlation to the degree of sea sickness. Individuals of the first group, in most cases, did not manifest a change in salivary surface tension on the benzol border, while those of the fourth group showed a sharp decrease. Some individuals whose salivary surface tension on the benzol border was very low before the experiment (about 20 din./cm.) complained of tiredness, insomnia, general sickness; though their surface tension did not drop any further, vomiting took place rapidly. Some individuals went through the experiment two or three times without a change in salivary surface tension, others showed different figures on different days, depending on their general condition.

A few experiments were also made after ascent in the barochamber to study the influence of partial air hunger on salivary tension. The saliva was collected before the ascent and 1, 2 and 3 h. after it. The tabulated results show a change in surface tension, but this time on the air border and not on the border of benzol. Only in one case, that of a schizophrenic, there was a change in surface tension both on the

border of air and of benzol, which was caused by the individuals' feeling of sickness.

Tests were also made in pilots after flights, showing a sharp decrease in surface tension on the border of air (55 din./cm. as compared to 64 din./cm. before the flight) when the airplane was flying at 3000 m. without tumblings or drops. A flight at lower altitude, but with tumblings and drops, showed a change in the pilot's salivary surface tension on the benzol border. The author sees in these data a possibility of determining whether the individual has been subjected to sea-sickness or hypoxemia.

Parallel investigations done at the author's laboratory have shown that, by its biological properties and surface tension, saliva approaches the blood serum and differs from the spinal fluid. Saliva has no smaller, and sometimes even a greater sympathomimetic effect on the frog's heart than the blood serum of the same individual. In the cases of low surface tension on the benzol border, the biological properties of the saliva did not coincide with its surface tension. This non-conformity may be due to the fact that sympathomimetic substances predominate and mask the effect of the parasympathomimetic. On the border of air there is a summary decrease of surface tension caused by albumin, fatty acids and lipoids; on the benzol border the action is mostly due to lipoids and fatty acids. Therefore the author assumes that the sympathomimetic substances manifest themselves on the air border, the parasympathomimetic on the benzol border.

In conclusion, the salivary surface tension of man changes, as a rule, in sea-sickness, gyration or hypoxemia.

Efimova, T. G., 1937. FIZIOLOGIĖA POD'IAZYCHNOI ZHELIUZY [The physiology of the sublingual gland]. *Eksper. Med. Kharkov*, 3: 103-108.

Study was made of the sublingual gland in one fistulated dog, whose submaxillary gland had been excised. The secretion was elicited by one rusk every 5 sec. during 5 min. (65 gm.).

No secretion appeared from the sublingual gland during 12 days after the operation, then started very weakly, and became normal only after 43 days. The secretion rate of the sublingual gland is extremely slow, 0.8 to 1.0 cc. in 2 hours, followed by a prolonged diminishment. The viscosity is many times greater than that of the mixed mucous saliva, the sublingual saliva being unable to flow through the capillary tube. The color is misty, but after many hours of standing it deposits no sediment. The percentage of dry residue is considerably greater than that of the mixed mucous secretion, often nearly double; the percentage of organic matter in sublingual saliva is much greater than in the mixed saliva.

After decerebration only one sample of saliva (0.4 cc.) could be obtained. A subsequent intravenous injection of 1% pilocarpine solution elicited 0.7 to 3.3 cc. of saliva; the dry residue and organic matter content was much lower than in the chronic experimentation, the percentage in inorganic matter was the same; the rate of secretion was considerably higher, 0.2 to 0.3 cc./5 min.

Ege, R. and E. Oklitz, 1930. DIE HALTBARKEIT DES PTYALINS IN VERSCHIEDENEN VERDÜNNUNGEN [The strength of ptyalin in different dilutions]. *Biochem. Zeitschr.*, 219 (4-6): 422-431.

Experiments were conducted to measure the reaction of the ptyalin content of various salivary concentrations at temperatures ranging from 56.5°C. to 63°C. Sørensen's buffer solution was used for dilution purposes.

Results have indicated that the dilution of saliva stimulated the speed of destruction of ptyalin in proportion to the dilution. While in the first experiment 100 minutes were needed for 50% reduction of ptyalin, in the last experiment only half a minute was needed.

When the enzyme concentration resulted from spontaneous destruction of the solution instead of dilution, the relationship between the concentration and strength of the enzyme was different. The reduction of the concentration of the active enzyme had only a slight effect on the strength of the enzyme. The speed of decomposition decreased with the increase in concentration. In order to explain this phenomenon it is assumed that the concentration of a so-called colloid stabilizer increased and this colloid compound reacted against the active ptyalin. The speed of decomposition was the same in spite of the fact that the concentration of ptyalin was twenty times lower in the last experiments than in the first one.

Ege, R., 1932. DIE EINFLUSS DER REAKTION AUF DIE ZERSTÖRUNG DES PTYALINS [The effect of (salivary) reaction on breaking down of ptyalin]. *Biochem. Zeitschr.*, 244 (4-6): 243-257.

The decomposition of salivary diastase was determined. The ptyalin activity was measured by the time necessary to induce the decomposition of the starches yielding a special color when exposed to iodine. The determination of the ptyalin concentration was dependent upon many factors. The decomposition of the salivary diastase was different in individuals, even when the salivary diastase concentration, reaction, phosphate, as well as sodium concentration was the same through several tests.

The optimum pH for ptyalin was 6.5. At 5.9 and 7.4, decomposition broke down almost to half. With the increase of the pH value, however, the decomposition process speeded up; this increase was more considerable the greater the rise above the optimum pH. At a strong acid reaction (lower pH than 3.2), the decomposition of ptyalin did not occur as a mononuclear process, which is usually characteristic of such processes.

Eggers-Lura, H., 1947. INVESTIGATIONS ON THE SALIVARY PHOSPHATES AND PHOSPHATASES. *Jour. dental Res.*, 26 (3): 203-224.

A short review of the literature on salivary phosphates and phosphatases is presented.

The author determined the salivary phosphate and phosphorus contents of normal resting saliva and of variously treated salivas (i.e. stored, heated, boiled, hydrolyzed, filtered, etc.). Diurnal variations are noted; the sites of the origin of salivary phosphatase are listed.

"1) In analyses of all phosphorus fractions, except in total phosphorus, rather significant shifts in the phosphorus concentration resulting

from the activity of the phosphatases, and resulting indirectly from the influence of the concomitant substances on these phosphatases, should be considered.

"2) When the saliva is left for some time, these shifts become particularly pronounced, as the enzymes are more resistant to storage than the phosphorus fractions. Hence the phosphorus analysis should be carried out immediately after the collection of saliva." (Author's summary.)

Eggers - Lura, H., 1948. THE ESTIMATION OF PHOSPHATE IN SALIVA. (A reply.) *Jour. dental Res.*, 27 (2): 169.

A short defense of this paper (cf. Lura, 1947m) is presented by the author in reply to a criticism by Davies (cf. Davies, 1948m).

Eggers - Lura, H., 1953. MICROGASOMETRIC ESTIMATION OF THE SALIVARY GASES. *Jour. dent. Res.*, 32 (5): 697-698.

The oxygen, nitrogen, and carbon dioxide content of the saliva of 100 persons was measured under standardized conditions. The mean oxygen content was 1.35 vol. percent $\pm$ 0.0002 in the saliva of caries-free and caries-resistant persons, and 0.51 vol. percent $\pm$ 0.0003 in the saliva of caries-active persons, these differences being highly significant. Seasonal variations corresponding to variations in redox potential were noted.

The nitrogen content, showing slight relation to caries, varied from 0.48 to 2.78 vol. percent. The carbon dioxide values, ranging from 13 to 85 vol. percent, depended chiefly upon the rate of stimulation. The bicarbonate content of stimulated saliva accounted for more than one-half of the total carbon dioxide content at pH 6.9.

Eggers-Lura, H., 1955. ELECTROCHEMICAL ESTIMATION OF THE PHYSICALLY DISSOLVED SALIVARY OXYGEN. *Jour. Dental Res.*, 34 (5): 751-752.

Use of a new electrochemical microapparatus (Todt and Teske, *Biochem. Zeitschr.*, 323: 192, 1952) permits the content of dissolved salivary oxygen to be estimated at 0.18 to 0.25 vol. % $\pm$ 0.01 at 25°C. This value corresponds to about half the content in water and is somewhat higher than the mean of the dissolved oxygen content of the blood. (From author's abstract)

Eggers-Lura, H., 1955a. INVESTIGATIONS INTO THE OXYGEN UPTAKE OF THE SALIVARY MICROFLORA WITH AND WITHOUT ADDED SUBSTRATES. *Jour. Dental Res.*, 34 (5): 752.

"The oxygen uptake of the salivary microflora has been measured in a Warburg manometer under standardized experimental conditions upon the nonstimulated salivas of 50 caries-resistant and 50 caries-susceptible children 5 to 16 years old. The caries resistance was associated with a high salivary respiration rate; the differences between the 2 groups being significant. The addition of different substrates influence the oxidizing processes both by the nature of and the concentration of the substrates. The "natural" carbohydrates, starch and maltose, are more easily oxidized than glucose, sucrose, and raffinose, in the same concentrations (0.2%). The salivas of caries resistant children generally are activated by the substrates in the concentration of 0.2%, while most of the salivas of

caries-active children are inhibited in oxygen uptake. An accumulation of the sugar beyond 5% completely stops the microflora respiration." (From author's abstract)

Eggers-Lura, H., 1955b. ACTIVATION OF THE PYRUVIC ACID OXIDATION OF THE SALIVARY MICROFLORA. Jour. Dental Res., 34 (5): 751.

"The oxidation of pyruvic acid by the salivary microflora as measured by the oxygen uptake in a Warburg manometer may be activated by the following substances; cozymase (DPN), adenosine triphosphate (ATP), aneurindiphosphate (thiamin), ascorbic acid, acetic acid, citric acid, and malic acid, cytochrome and nitrite, while the addition of KCN, CO, and malonate inhibit the respiration. Fluoride does not influence the salivary respiration in a concentration of M/1000." (Author's abstract)

Eggers-Lura, H., 1955c. INVESTIGATIONS INTO THE AEROBIC AND ANAEROBIC DEGRADATION OF GLUCOSE IN SALIVA. Jour. Dental Res., 34 (5): 752.

Salivary analyses of lactic and pyruvic acids after aerobic and anaerobic incubation of glucose and saliva, while measuring the O₂ uptake in a Warburg manometer, showed that caries-resistant salivary types form more acid faster than caries-active types. The oxidations of these acids will occur at a faster rate in the caries-resistant salivary types. Measurement of the pH and of the Eh of the incubated salivary samples confirmed the results: caries-active salivas showed a slower acid formation and Eh values were generally lower than those found after incubation of the caries-resistant types. (Author's abstract)

Eggers-Lura, H., 1955d. INVESTIGATIONS INTO THE OXIDATION-REDUCTION POTENTIAL OF SALIVAS FROM CARIES-RESISTANT AND CARIES-SUSCEPTIBLE PERSONS. Jour. Dental Res., 34 (5): 752.

Eh measurements of stimulated and bicarbonate-containing saliva in open vessels with platinum and calomel electrodes show a stable potential useful for characterizing single salivary types or measurements made at different times of the day. For a caries-resistant group of 50 persons the mean Eh value was $+ 309 \pm 4.7$ mv.; for a caries-active group of 50 persons, 237 ± 9.9 mv. The differences between the two groups are significant. The saliva of the caries-resistant apparently is oxygen-saturated; the potential of such saliva is not markedly raised on passage of pure oxygen. The addition of hydrogen peroxide however causes a rapid rise of salivary potential due to salivary peroxidase and catalase. Addition of substances activating the oxidizing processes of the salivary microflora as cytochrome, adenosine triphosphatase, and cozymase will raise the potential. Differences between the caries resistant and active groups are possibly due to differences in salivary content of oxidizing enzymes and biologic redox system (sulfhydryl systems, coenzymes, vitamins), or differences in salivary microflora associated with the more aerobic oral ecology of the caries-resistant subjects. (From author's abstract)

Eggers-Lura, H., 1955d. PAPER CHROMATOGRAPHY OF ADENOSINTRIPHOSPHATE IN THE SALIVAS OF

CARIES-RESISTANT AND CARIES-SUSCEPTIBLE SUBJECTS. Jour. Dental Res., 34 (5): 753.

Detection and separation of salivary energy-rich phosphorus compounds, using the method of Eggleston and Hems (Biochem. Jour., 52: 156, 1952), shows the saliva of caries-resistant subjects to have a greater ATP content than the saliva of caries-susceptible subjects. (From Author's abstract.)

Eggers-Lura, H., 1958. ACID FORMATION IN SALIVA AND PLAQUES. Jour. dent. Res., 37 (5): 969.

Investigations into the content of lactic acid and pyruvic acid in saliva and plaque material have formerly been made with colimetric methods which were rather inaccurate and unspecific. The new "enzymatic test method" (Boehringer Test Combinations, TC-B-C-G 15972-73-77) has been introduced for the first time in odontology and makes it possible to determine the content of lactate and pyruvate together with the lactic acid dehydrogenase activity, very exactly. It was found that the values given in previous investigations, using colorimetric methods, have been too high. By the enzymatic test method the author's previous results were confirmed, namely, that glycolysis and acid formation are more pronounced in the caries-resistant material than in the caries-active. Also, the dehydrogenase activity is as great in the caries-resistant as in the caries-active material and generally greater in the saliva than in the plaque. (Author's abstract)

Eigler, Gerhard, 1939. UBER DIE WIRKUNG DER SPEICHELAMYLASE VOR UND NACH DER TONSILLECTOMIE [On the action of salivary amylase before and after tonsillectomy]. Arch. f. Ohren-, Nasen-, u. Kehlkopfheilk., 146 (2): 105-110.

The salivary amylase activity in healthy persons was studied before and after tonsillectomy. Preliminary experiments on 28 individuals indicated that filtered saliva (i.e., free of any corpuscular elements) possessed an amylolytic action similar to unfiltered saliva. Further tests showed a preservation of the normal amylolytic strength in 16 individuals 9 days after tonsillectomy; 2 other persons, however, whose salivas were tested on the 12th and 13th day after tonsillectomy, had only 25% and 18% respectively of their original amylolytic activity. The author attributes this decrease in amylolytic activity to a loss of lymphatic cell elements which, he maintains, possess an activating force in regard to the enzymic activity of saliva.

Eisenberg, Moses. J., 1926. TREATMENT OF HYPER VISCID SALIVA. Amer. dental Surgeon, 46 (6): 425-427.

A report of findings, which are based upon eight years of office observations, is presented concerning the conditions promoting hyper viscid saliva: pregnancy, nervous disorders, high protein diet. Also included and described are an apparatus (Eisenberg's modification of Smith's Viscosimeter) for salivary viscosity measurements, a suggested prescription for treating the disorder, and a discussion of possible oral conditions which may result from extremely mucoid saliva.

Eisenbrandt, L. L., 1943. INITIAL OXIDATION-REDUCTION POTENTIALS OF SALIVA. Jour. dental Res., 22 (4): 293-299.

The method used in testing the oxidation-reduction activities of saliva after spitting, was as follows: approximately 5 ml. of normal, unstimulated saliva was collected within the closed mouth, spit into a cup and tested. Oxidation-reduction potential readings (E_h) were taken at temperatures averaging 28°C . Both pH and E_h were measured within 1-1/2 minutes after filling the cup. A pH- E_h meter with a gold plated platinum electrode was used.

A statistical analysis was made of 252 readings (salivary samples taken from 5 individuals 5 times daily). The mean E_h was found to be $+261 \pm 1.88$ mv (the last number being the standard error of the mean), and digressions of the individual subjects from the group mean were negligible. Variance among subjects was insignificant, as also was the decrease of E_h during the day (as shown by bi-hourly checks). The greatest change in E_h occurred between 9 and 11 o'clock in the morning (+14).

There was a significant inverse relationship existing between the pH and the E_h . Although the coefficient of correlation was -2.8, the t value was 0.160 and the value for 1% significance was 0.163, supporting the existence of an inverse relationship.

Eisenbrandt, L. L., 1943a. VARIATIONS IN THE pH OF SALIVA OF FIVE INDIVIDUALS. Jour. dental Res., 22 (2): 147-156.

Using a glass electrode, 276 determinations were made of the salivary pH of 5 individuals. The average pH was 6.72 $\pm$ 0.015. However, the pH varied considerably among individuals, averaging 6.78, 6.59, 6.71, 6.66, and 6.84, respectively.

Bi-hourly pH determinations (total of 252) indicated that significant variations among the individuals occurred at 9 a.m. and probably at 11 a.m.; and the group as a whole was significantly at variance from the daily mean at 9 a.m. and probably at 5 p.m. The individual pH values tended toward homogeneity as the day progressed.

With one exception, there was no significant deviation within each of the five periods of daily observation for each subject from his respective mean for the period, or for the same bi-hourly period on different days.

Eisenbrandt, L. L., 1944m. STUDIES ON THE pH OF SALIVA. Jour. dental Res., 23 (5): 363-374.

The purpose of this paper was to show that pH variations in saliva are not haphazard and to demonstrate group and individual characteristics.

The experiment consisted of 1552 tests on the salivary pH of 7 persons (5 men and 2 women) over a period of one year with monthly and bi-hourly (in daytime) tabulations. The method was that employed in previous work (Eisenbrandt, 1943m). The average pH was 6.64. The standard deviation, $\pm$ 0.0254 and standard error of the mean, $\pm$ 0.006. The pH of the single samples ranged from 5.28 to 7.48.

Group variation of pH was marked during the year, with highest pH in October and November, and lowest in May. The changes appeared to fall

into seasonal patterns. The monthly means ranged from 6.55 to 6.72.

Resulting data showed individual variation in salivary pH to follow the trend of the group and suggested an average pH, characteristic for each individual. At least 100 tests were made on the saliva of each subject, with 5 of the subjects averaging 265 tests each.

Bi-hourly variations in the pH of the saliva were recorded. The annual mean of the group was at 1 p.m. (6.64), with the lowest pH at 9 a.m. (6.55) and the highest at 5 p.m. (6.71). The group salivary pH varied significantly from month to month at each bi-hourly period, and when compared at 5 bi-hourly periods for each month, the variability was significant only in May, June, July, and October.

Eisenbrandt, L. L., 1945. INITIAL OXIDATION-REDUCTION POTENTIALS OF SALIVA. Jour. Dental Res., 24 (3/4): 194-195.

"The initial oxidation-reduction potentials (E_h) of unstimulated saliva of 7 subjects tested repeatedly disclosed that this physiological property is a function of time (monthly and seasonal). A total of 1555 electrometric determinations was made bi-hourly from 9 A.M. to 5 P.M. for 1 week in each of 12 consecutive months. The mean E_h of the saliva was +301 mv. and the mean pH was 6.64. Although the pH showed marked individual characteristics, the initial oxidation-reduction potentials of saliva did not vary to any extent. Also, the pH of saliva changed greatly during the day, but the oxidation-reduction potentials did not. Both E_h and pH showed significant variations in the saliva of the group from month to month. The E_h was below the mean during the fall (+248 mv. in November), winter and spring, but was above the mean during the summer, reaching the high E_h of +394 mv. in September, i.e., the warmest period of the year. The pH of the same saliva was high in the fall (6.72 in October), low at mid-winter (6.56 in January), high in the early spring (6.68 in March) and low again in the early summer (6.53 in May). Seasonal variations in the incidence of caries and Vincent's infection, as well as other diseases, have been reported. A relationship between these pathological manifestations and oxidation-reduction potentials may eventually be established because of seasonal cycles. Also, on the same basis there is a relationship between E_h and the activity of the thyroid gland. High environmental temperature and humidity increase the effects of thyroxin, and likewise E_h is apparently influenced in the same manner. (To be published in the J. D. Res.) (Author's abstract)

Eisenbrandt, L. L., 1945a. STUDIES ON THE OXIDATION-REDUCTION POTENTIALS OF SALIVA. Jour. dental Res., 24 (5): 247-257. Abstract: Jour. dent. Res., 24 (3/4): 194, 1945.

Studies were made on the oxidation-reduction potentials of the saliva of 7 persons available for periods of time ranging from 4 months. (1 individual) to one year (4 individuals). Variations were noted from 9 a.m. to 5 p.m. each day for 1 week every month. The procedure, subjects, time, and statistical methods were the same as those described by Eisenbrandt [cf. Eisenbrandts, 1943m].

The mean oxidation-reduction potential (E_h) for the total of 1555 readings was +301 mv. and the standard error of the mean, +183. The single readings ranged from +158 to +542 mv.

The monthly means of the group E_h of the saliva differed significantly from the annual mean, with greatest positive deviation in September (+93 mv.), greatest negative deviation in November (-53 mv.), the E_h for June (+293 mv.) being nearest to the mean. No explanation is offered for the apparent seasonal variance in human salivary E_h .

When individuals were tested under identical conditions there were no variations of E_h from individual to individual.

The monthly E_h for the subjects' salivas varied noticeable from month to month, yet were remarkable similar in their variance, being low for all in the fall months and high during late summer. The author suggests that temporary oxidation-reduction potentials are possibly a function of time on a monthly or seasonal basis.

Bi-hourly measurements showed no fluctuation during the day in the E_h of saliva for the group, yet marked fluctuations occurred from month to month at each of the 5 bi-hourly periods. The monthly mean E_h for 9 a.m. ranged from +250 mv. in November to +397 mv. in September. Bi-hourly comparisons of the E_h of subjects' salivas showed little difference while there was significant variance for each individual at a particular bi-hourly period of each month of the year.

Ellison, S. A., and P. A. Mashimo, 1958. IMMUNOCHEMICAL STUDIES OF SALIVA. Jour. dent. Res., 37 (1): 28.

In order to study the relation between the composition of saliva, the physiology of its secretion, and oral disease, it is necessary to detect and measure individual macromolecular components. Immunochemical technics were applied to the study of saliva. Antisera were prepared in rabbits employing alum-precipitated saliva as antigen and these were examined by a gel diffusion technic. The antisera were tested simultaneously against a number of antigens among which were whole and fractionated saliva, serum, and purified serum proteins, and amylase. The presence of at least 4 unaltered serum proteins in saliva was ascertained. The occurrence of β -globulin and γ -globulin was inferred from the finding that antibodies which reacted with these proteins were present in the antisera. In addition, at least 4 specific and distinct salivary proteins were detected. Further applications of these methods are in elucidating salivary composition, in qualitative studies of specific components, and in their use as a guide in attempting fractionation of saliva. (Author's abstract)

Elovskikh, A. S., 1937. MATERIALY O SEKRETSII OKOLOUSHNOI ZHELEZY U TELIAT [Contribution to parotid secretion in calves]. Fiziol. Zhur. SSSR, 23 (3): 366-375.

Parotid secretion was studied in calves under various conditions: before or after meals, under various stimulations per os, at different ages, and during or without rumination. 240 experiments were made in three animals aged from 3 weeks to 7 months, with fistulated Stensen's

duct and fistulated paunch. The animals were fed according to laboratory standards, with addition of sodium bicarbonate and kitchen salt, and weighed periodically. Spontaneous salivary secretion was first studied after a starvation period of 18 to 20 hours, during 3 to 4 hours; each 5-minute sample was examined.

Results show a continuous parotid secretion in calves 3 or more weeks old. This secretion is subject to variations, before the meal as well as after it, depending essentially on the functional condition of the gland, the preceding stimulation, rumination periods, outside stimulations, as the amount and quality of the food, and the influence of the forestomach.

The absolute amount of salivary secretion increases with age. At suckling age, the amount of parotid secretion is greater on an empty stomach than on a full stomach; at the transition age, and especially at the period of the coarse food diet, the after-meal secretion is greater and the variations in the secretion rate more frequent than on an empty stomach. At the early suckling age, the saliva of calves is very viscous; at the age of 3 to 5 months it becomes transparent and watery.

An increase in salivary secretion is produced by the following substances: hay, grass, dry bran, bread rusks, crystals of cooking salt or tartaric acid, saturated salt solution, 5 to 10% tartaric acid solution, 5 to 15% acetic acid solution, 45 to 50% alcohol, fine sand, red brick powder, dry earth with small pebbles or small bricks, and the chewing of inedible substances.

Depression of salivary secretion results from water, milk, greatly diluted bran and other liquid food, as salt solution not over 5%, a 1% solution of hydrochloric acid, a 10% solution of sodium salt, the liquid content of the paunch and the abomasum, finely-chopped course, branches, sand, gravel and red brick of the gravel size.

The act of chewing exerts an influence on the increase of secretion, but less than the stimulation per os.

Elovskikh, A. S., 1937a. DANNYE O VLIYANII SO STORONY RUBTSA NA SLIUNOOTDELENIE OKOLOUSHNOI ZHELEZY [Data on the influence of the paunch on the secretion of the parotid gland]. Fiziol. Zhur. SSSR, 23 (3): 377-379.

The influence of the paunch on parotid secretion was studied in 3 calves, 3 to 7 months old, with fistulated paunch and Stensen's duct. The animals were fed standard amounts of milk, bran, and hay; salt and sodium carbonate were added to the food. Salivary registration was done by the usual method (a glass balloon with 2 tubes, one of which is connected through a rubber tube with a graded cylinder). Introduction of the stimuli into the paunch was done alternately, after a basically stabilized salivary secretion had been obtained. Saturation of the paunch with air was done by means of Richardson's balloon, and the pressure registered by a water manometer. Experiments did not last over 3 to 3.5 hours.

Introduction of water into the paunch during 3 to 4 min. results in a depression of salivary secretion, lasting 25 to 40 minutes. The more water is introduced, the sharper the depression of salivation and the longer the duration of depression. The inhibitory effect is stronger in older calves (5 to 6 months). The return to

normal secretion is obtained quicker, if the water has been poured into an empty paunch. The temperature of the water has no influence.

Artificially-increased atmospheric pressure in the paunch (up to 10 - 16 cm.) results in a very sharp depression of salivary secretion. At a pressure of 14 to 16 cm. the salivary secretion may stop completely. Increased atmospheric pressure stops the rumination, if it had already begun; if the pressure is lowered, rumination may return after a few minutes. Lowering of the pressure to normal also reestablishes the salivary secretion to its previous rate. The presence of a chronic paunch fistula in one calf had no effect on the salivary secretion; neither does an empty or a full stomach, or the motor activity of the paunch influence salivation.

Elphinstone, J. L., 1925. EXCESSIVE FLOW OF SALIVA CAUSED BY A LOWER ARTIFICIAL DENTURE PRESSING ON THE SUBLINGUAL GLANDS. *Dental Cosmos*, 67 (10): 1023.

A copious flow of saliva in a patient is considered to have been caused by pressure of a lower denture which, following resorption of the bony process of the jaw, exerted pressure on the sublingual glands. The nature of the saliva indicated involvement of the submaxillary and parotid glands.

Elsberg, Charles A., H. Spotnitz, and E. I. Strongin, 1940. THE EFFECT OF STIMULATION BY ODOROUS SUBSTANCES UPON THE AMOUNT OF SECRETION OF THE PAROTID GLANDS. *Jour. exper. Psychol.*, 27 (1): 58-65.

The effect of the stream injection of odors into the nasal passages on the secretory activity of the parotid gland was studied. The parotid secretion remained fairly constant in a group of 50 normal individuals. The injection of odorous substances as citral, menthol, and turpentine, which have a definite trigeminal nerve effect, caused a marked increase in the parotid secretion. However, substances like coffee and phenyl ethyl alcohol had little, if any, effect on the secretion. The injection of substances into one nasal passage increased the secretion from the ipsilateral parotid gland, while a bilateral injection caused an increase in the secretion of both glands.

Elsberg, C. A., H. Sponitz, and E. I. Strongin, 1942. THE OLFACTORY-PAROTID REFLEX. STUDY OF ONE HUNDRED AND FIFTY PATIENTS WITH DISORDERS OF THE CENTRAL NERVOUS SYSTEM; A PRELIMINARY REPORT. *Arch. Neurol. and Psychiat.*, 47 (5): 707-717.

A study was made in various neurologic patients concerning the pathways of the olfactory-parotid reflex (an unconditioned salivary response resulting from stimulation of the nasal passages by substances with odor), variations in the resting-rate of parotid secretion, and variations in parotid secretory volume due to the influence of the olfactory-parotid reflex. The amount of parotid secretion was measured every 30 seconds for 20 to 30 minutes before stream injection of citral into the nasal cavity (resting secretion), during, and for 15 minutes after such stimulation. The resting rate of parotid secretion in such patients was found to be either abnormally high or low, and the reflex

response to citral was either hyperactive or underactive. Data suggested that the afferent pathway of the reflex involved the trigeminal and facial nerves.

Elzay, R. P., and J. C. Muhler, 1958. EFFECT OF CARBOHYDRATES ON SALIVARY GLAND FUNCTION IN THE RAT. *Jour. dent. Res.*, 37 (1): 53-54.

The effect on salivary viscosity produced by ingestion of large amounts of refined carbohydrate was investigated in laboratory animals where the experimental conditions could be carefully controlled. The diets varied in sucrose content from 20 to 60 percent. Salivary flow was measured by stimulating gland activity with pilocarpine, and viscosity determined by special technics developed for this study which essentially involve measuring rate of passage of saliva through a calibrated tube. The results indicated no difference in salivary flow, but marked difference in salivary viscosity. The higher the carbohydrate content of the diet the lower the salivary viscosity. (From author's abstract.)

Emchenko, A. I. 1949. ZAKONOMERNOSTI V SEKRETSII NEORGANICHESKIKH SOEDINENII SLIUNY SOBAKI [Regulation of the inorganic components of salivary secretion in dogs]. *Trudy Instit. Fiziol. Zhivotnykh Kiev. Univ.*, Kiev, 5: 171-212. *Abst.: Sovet. med. refer. Obozrenie, Fiziol.*, 1952 (9): 87-88.

Prolonged as well as some short-termed tests were conducted in the dog to study the chemical composition of parotid and mixed saliva. Salivary determinations were made, in the short-termed tests, of the presence of several salts injected intravenously into normal dogs. Salivary secretion was stimulated with food or chemical stimuli. The methods of determining salivary calcium, potassium, alkaline reserve, and salivary refraction are described.

Results show that the saliva contains less sodium and chlorides than does the blood plasma, but three to five times more potassium, more calcium and more sodium bicarbonate. The injection of CaCl_2 increased the calcium content of the saliva, and the calcium level in food-stimulated parotid saliva was higher than that of the blood. General rules were noted regarding changes in the salt content of saliva secreted under various circumstances. The salivary concentration of potassium and calcium chlorides was independent of either the secretion rate or quality of saliva while the concentrations of sodium chloride and bicarbonate varied with the secretion rate. The refraction index changes considerably with fluctuation of the albumin content of saliva. The salivary salts are considered to be related to the secretory process; their passage across the glandular membranes are active and not passive, indicating the physiological importance of the salivary glands.

Emerson, Charles P., and O. M. Helmer, 1934. A STUDY OF THE SALIVARY AMYLASE IN PATIENTS WITH PERNICIOUS ANEMIA. *Jour. Lab. clin. Med.*, 19 (4): 504-506.

The salivary amylolytic activity of 19 persons (14 with pernicious anemia and 5 normal) was studied in order to ascertain whether the salivary glands were affected in anemia. A method suitable for the quantitative determination of salivary

amylase is described in full. No significant amylase deficiency was observed in patients with pernicious anemia.

Engelgardt [Engelhardt], V., and M. Gerchuk, 1925. MIKROMETOD OPREDELENIYA AMILAZY [The micromethod of amylase determination]. Zhur. eksper. Biol. Med., Moskva, 2: 88-101.

Detailed description is given of a new method of amylase determination applicable to salivary studies. The method is based on sugar formation rather than depolymerization of starch and gives more accurate results than Wohlgemuth's method.

Englander, H. R., I. Shklair, and L. S. Fosdick, 1958. THE EFFECT OF SALIVA ON THE RATE OF ACID FORMATION IN DENTAL PLAQUES. Jour. dent. Res., 37 (1): 73-74.

Dental plaques from certain locations of the upper molars were removed before and at 5-, 10-, 15-, and 20-minute intervals after the application of a 50 percent sugar solution. The pH was determined on each sample after which it was analyzed for lactate acid. The free lactic acid and the neutralized lactic acid of each sample was calculated by means of the Henderson-Hasselbalch equation $pH = pK_1 + \log BA/HA$. Two series of plaques were removed from each individual. The first series was performed under conditions which permitted free access of the saliva while, in the second series, no saliva was permitted to contact the areas under study. The pH and lactate content of the plaques which were taken in the presence of saliva were compared with those taken in the absence of saliva. It was found that in caries-active subjects the plaques remained acid for a longer period of time in the absence of saliva, although the total amount of lactate formed was approximately the same in the presence as in the absence of saliva. On the basis of the results, it is concluded that the saliva plays a very important role in the neutralization of acids, in dental plaques. The results further indicated that, under normal circumstances, very little of the lactate formed is washed from the area by the saliva or metabolized by the organisms present. (Author's abstract)

Englander, H. R., L. M. Mau, K. C. Hoerman, and H. H. Chauncey, 1958a. DENTAL CARIES ACTIVITY, AND THE pH, TITRATABLE ALKALINITY, AND RATE OF FLOW OF HUMAN PAROTID SALIVA. Jour. dent. Res., 37 (5): 906-911.

The pH, titratable alkalinity, and rate of flow of the parotid salivas from 30 caries-free males and 52 with rampant-carries were determined under standard conditions of collection. No differences in pH, titratable alkalinity, and rate of flow existed between these two extreme groups. Parotid saliva specimens were collected from each of 5 subjects using varying degrees of stimulation which produced different rates of flow. In all cases, both titratable alkalinity and pH varied directly with rate of flow. Titratable alkalinity increased at a rate characteristic for each person studied. (Author's summary)

English, James A., and J. L. Tuttle, 1951. ORAL MANIFESTATIONS OF IONIZING RADIATION. Jour. dent. Res., 30 (1): 33-52.

A description is given of pathological changes in oral tissues, salivary glands, and developing teeth of 41 healthy young swine exposed to a total body X-ray irradiation of 2000 KV in doses ranging from 250 to 800 r in air.

Examination of gross changes in the oral mucosa showed petechial and ecchymotic hemorrhages in 20 of the 41 animals; marked ulceration was noted in 4 swine. The gingivae and hard palate were less commonly involved. Histological study revealed irregular erosions of the mucosa in about 30% of the swine. Petechial or massive hemorrhage was noted around the developing teeth of 70% of the animals. Lymph nodes of the submaxillary region showed hemorrhage and marked depletion of lymphoid cells indicating high sensitivity to the irradiation. Salivary glands showed a reduction of basophilic granules within mucous cells; serous glands were not similarly affected. Recovery of the gland was complete in swine of the 450-500 r group which survived beyond 30 days.

Ennever, J., H. I. Myers, and A. Saeger, 1952. A CORYNEBACTERIUM ANTAGONISTIC TO ORAL LACTOBACILLI. Jour. dental Res., 31 (4): 502-503.

"From pour plates of 1:1,000 saline-diluted saliva in beef heart infusion agar, covered after 96 hours at 35°C. with tomato juice agar pours of *Lactobacillus casei* (ATC-4646) and reincubated 72 hours, a microorganism showing zones of inhibition against the lactobacillus was recovered. The characteristics of the antagonist demonstrated marked, though not absolute, resemblance to *Corynebacterium enzymicum*. It inhibited lactobacilli isolated from the mouths of 10 subjects but showed no activity against *M. pyogenes* var *a* [*u*] *reus*, *B. subtilis* (ATC-6633B), *E. coli* (ATC-9637), *A. aerogenes* (ATC-8724) and 3 oral yeasts. *C. enzymicum* (ATC-8155, 8156) failed to affect the growth of any of the microorganisms acted upon by the isolated antagonist. As yet, cell free activity has not been obtained." (Complete paper.)

Ennever, J., H. B. G. Robinson, and P. C. Kitchin, 1953. EFFECT OF THREE DIPHENYLMETHANE DERIVATIVES ON ACID PRODUCTION IN SALIVA AND ON LOGARITHMIC GROWTH OF AN ORAL LACTOBACILLUS. Jour. dent. Res., 32 (1): 61-64.

A study of the effects of dihydroxyhexachlorodiphenylmethane (G-11), dihydroxyquadrochlorodiphenylmethane (XDR-504), and dihydroxydibromodiphenylmethane (XDR-505) showed that all three, in high dilutions, were capable of altering the logarithmic growth of an oral lactobacillus and were able to inhibit acid production in pooled saliva.

Enright, J. J., H. E. Friesell, and M. O. Trescher, 1932. STUDIES OF THE CAUSE AND NATURE OF DENTAL CARIES. Jour. dent. Res., 12 (5): 759-827, discussion, p. 828-851. Abstract: Jour. dent. Res., 12 (4): 570-574.

A detailed literature review introduces the first complete report of a six-year study of various local factors involved in dental caries. Studies on saliva, its pH and chemical composition, on enamel characteristics and on lactobacilli are included.

Ericsson, Yngve, 1951. ON THE SALIVARY AMYLASE AND ITS SIGNIFICANCE IN THE CARIES PROCESS. *Acta Odontol. Scandinav.*, 9 (2): 89-110.

A literature survey is presented of the nature of salivary amylase, the factors affecting its oral activity, and the relationship to dental caries. Determinations were made of salivary amylase activity using iodine tests in 38 experiments to detect starch splitting; results were found consistent with reduction tests made in 30 of these experiments to detect the resultant maltose. Tests of paraffin-stimulated saliva, with and without addition of toluene to eliminate activity of the salivary flora, showed the amylolysis to proceed independent of salivary bacteria. Previous findings were confirmed regarding individual fluctuations in salivary amylase activity, diurnal variation in amylase content of saliva, as well as differences in this salivary constituent dependent on the type of salivary stimulation. The time required for clearance of reducing substances was investigated after ingestion of bread and potato; comparison was made in some cases with tests measuring clearance time after ingestion of cane sugar. Findings are tabulated and discussed.

Ericsson, Y., and L. Stjernstrom, 1951a. SALIVA VISCOSITY MEASUREMENTS. *Oral Surg.*, 4: 1465-1474.

The viscosity of saliva was measured with a Hess viscometer. In tests of mixed saliva a decreasing viscosity was noted, the change occurring most rapidly just after the sample was taken. Most mandibular salivas showed slow or no decrease in viscosity. Suspensions of oral bacteria, a amylase solutions, ascorbic acid alone, and hydrogen peroxide alone had no obvious effect on the viscosity pattern. Ascorbic acid, in the presence of either hydrogen peroxide or copper ions, strongly reduced the viscosity. The evidence indicates that reduction in viscosity is due to splitting of the mucin.

Ericsson, Yngve, and Hans Öberg, 1952. A NOMOGRAM FOR THE DETERMINATION OF CALCIUM PHOSPHATE SATURATION AND CRITICAL pH LEVEL IN THE SALIVA. *Acta odontol. Scandinav.*, 10 (2): 67-70.

A simple alignment nomogram is constructed to permit rapid determination of the hydroxy apatite saturation and critical pH level of saliva, below which the saliva is unsaturated and favorable to dissolution of the apatite from dental enamel (Ericsson, 1949).

Ericsson, Y., and I. Hellström, 1952a. THE LACTIC ACID CONTENT OF THE SALIVA AFTER CARBOHYDRATE INGESTION. II. SOURCE OF THE SALIVARY LACTIC ACID AND INHIBITION OF ITS FORMATION. *Acta odontol. Scandinav.*, 10 (3-4): 118-133.

Samples containing at least 0.2 ml. of mixed resting saliva were collected from subjects, fasting for 45 minutes and 2, 5, 10, 20, and 30 minutes after ingestion of 1.5 gm. of cane sugar; colorimetric analysis was made of the lactic acid content. Analysis of parotid and mandibular salivas, collected by glass ejector from the duct orifice of subjects found to have appreciable salivary lactate content after standard ingestion, showed a lactate content similar to fasting saliva; in vitro incubation at 37°C. for 5 to 30 minutes, of glucose mixtures of unstimulated saliva from 3 of these subjects showed little increase in

lactate content. Further salivary tests were conducted in subjects before and after removal of pronounced plaques, before and after removal of teeth, as well as with and without dentures *in situ* in full denture cases. The only consistent difference in salivary lactate content was found in the complete denture cases. The results indicate that the increase in salivary lactate is not glandular or salivary origin but is formed by oral bacterial aggregates on tooth surfaces and mucous membranes; the lactic acid is not evolved primarily by plaque bacteria. Tests involving a one-minute oral rinse with 15 ml. of a 0.5% solution of sodium fluoride, prior to the sucrose ingestion, showed partial inhibition of the subsequent lactic acid formation; use of an oral troche incorporating the sucrose and either penicillin or aureomycin also showed partial inhibition of lactic acid formation persisting 5 hours after administration of penicillin or aureomycin.

Ericsson, Yngve, 1953. INVESTIGATIONS OF THE OCCURRENCE AND SIGNIFICANCE OF CITRIC ACID IN THE SALIVA. *Jour. dent. Res.*, 32 (6): 850-858.

Samples of unstimulated mixed saliva of 6 adult subjects were collected before and at 2, 5, 10, and 20 minutes after ingestion of citrus fruits and beverages; the citrate concentration of the saliva was determined. An increased salivary citrate content was found after ingestion. After 10 minutes the level again approached the fasting value. It is suggested that the increased citrate content is due to intraoral retention.

In equilibrium experiments in the pH range from 5 to 7.5, the increased citrate concentration had no apparent effect on calcium phosphate solubility in the saliva.

Ericsson, Y., I. Hellström, B. Jared, and L. Stjernström, 1954. INVESTIGATIONS INTO THE RELATIONSHIP BETWEEN SALIVA AND DENTAL CARIES. *Acta odontol. Scandinav.*, 11 (3-4): 179-194.

Analysis was made of the salivation rate, amount of secretion, and amylase activity of unstimulated saliva of 31 caries-resistant and 32 caries-active subjects, aged 20 to 30 years; study was also made of their salivary lactate and glucose levels before and after ingestion of white bread. Higher average sugar and lactate levels were found in the salivas of the caries-active group during the 30 minutes after bread ingestion. Statistically-significant positive correlations were found between the glucose and lactate contents of the salivas of both groups. A slightly higher salivation rate and flow in the caries-resistant, as well as positive correlations between the secretion rate and flow of saliva and the glucose and lactate elimination were found to be of weak statistical significance. No group differences or correlation to other factors were found regarding salivary amylase activity.

Ericsson, Yngve, 1955. SIMPLIFIED METHODS FOR DETERMINATION OF CALCIUM AND MAGNESIUM IN THE SALIVA. *Jour. Dental Res.*, 34 (1) 104-112.

Descriptions are given concerning two analytic methods for the colorimetric determination of calcium and magnesium in small (1 ml.) samples of saliva. The sum of Ca and Mg are determined, with a precision of 1.5%, by titration with ethylene diamine tetraacetic acid using Eriochrome Black T

as an indicator. Mg is determined using titan yellow as an indicator. Twenty-five analyses of individual samples of stimulated saliva showed salivary Mg to vary between 0.13 and 0.23 mM/l., with a mean of 0.18 mM/l. Twenty-nine analyses of resting salivas showed a mean Mg concentration of 0.228 mM/l., with standard deviation of 0.055 mM/l.

Ermol'eva, Z. B., I. S. Buřanovskaiā, and A. M. Kalfūzhanaiā, 1933. O LIZOZIME [On lysozyme]. Zhur. Mikrobiol. i Immunol., 11 (4): 683-689.

The author has found lysozyme in the white of egg, in tears, mucus, saliva, in Bizzozero's platelets, and in various organs of animals, also in fish caviar and fish liver and pancreas. A study on the properties of lysozyme is made.

Erofeeva, Maria, 1912. STARKE FARADISCHE HAUTREIZUNG ALS BEDINGTER ERREGER DER SPEICHEL-DRUSENARBEIT BEI HUNDEN [Strong faradic skin stimulation as a conditioned stimulator of salivary gland activity in dogs]. St. Petersburg med. Zeitschr., 37 (7): 99.

Application in three dogs of a strong faradic stimulus to the skin produced an increasingly strong defense response. Simultaneous application in these dogs of the dermal stimulus and an oral stimulus, using a meat-bread powder, induced a conditioned salivary response to the faradic stimulus accompanied by gradual disappearance of the defence reaction. Substitution of an acid stimulant for the food stimulant produced no inhibition of the defence reaction. Prolonged application of a 0.21% HCl solution to the skin failed to induce a salivary conditioned response to the acid but the defense reaction disappeared.

Ersner, Matthew S., David Myers, and William Ersner, 1934. A CLINICAL AND EXPERIMENTAL STUDY OF THE ACTION OF SALIVA ON BLOOD COAGULATION AND WOUND HEALING IN SURGERY OF THE ORAL CAVITY AND THROAT. Ann. Otol. Rhinol. and Laryngol., 43 (1): 114-145.

Saliva was obtained by chewing paraffin and blood was taken from the median basilic vein. The coagulation time (Howell method) of blood from healthy persons was found to be from 10 to 30 minutes.

Blood in 2 cc. amounts was added, immediately as it was taken from the vein, to test tubes containing 2 cc. of saliva. Coagulation began immediately and the coagulation time markedly decreased (2 to 3 minutes). The time was not materially different whether the saliva was fresh, exogenous, autogenous, centrifuged, filtered (supernatant or sediment), or up to 24 hours old (kept at room temperature or on ice). Gastric juice added to the blood and saliva preparation as above, increased the clotting time; increasing the amount of saliva used in the test, or adding sodium bicarbonate or calcium gluconate restored the original shortened clotting time. Although vomiting may -- by the presence of acid vomitus in the oral cavity -- lessen the salivary effect of decreasing the clotting time, the onset of vomiting is known to bring about a reflex flow of saliva which probably more than compensates for it.

Immediately on expectoration, the pH of saliva was found to be 6.8 to 6.6 and this seemed to be optimal for salivary activity. Addition of dilute HCl to the saliva, showed the saliva to be active

in promoting clotting through the pH range of 6.8 to 4.8 but ineffective below 4.8.

A synthetic saliva, made up of the known percentages of inorganic constituents, did not affect the clotting time, nor did the individual constituents. Various mouth washes, gargles and solutions -- many of which are recommended following tonsillectomy -- had likewise no effect. Solutions containing aspirin -- or the chewing of aspergum -- increased greatly the coagulation time, and may well be the cause of continued postoperative bleeding of tonsillectomies so treated.

Saliva did not contain an agglutinin for *Streptococcus salivarius*, nor did it, in the one person whose saliva and erythrocytes were studied, contain any agglutinins for human erythrocytes.

Saliva collected continuously over a 4-hour period while chewing paraffin, was less viscid and more fluid, was of the same pH (6.6) at the close of the third hour as at the beginning, and retained its ability to coagulate blood in the same shortened period of time.

After the application of some of these findings to oral surgery, the authors recommend that it is best to depend on the inherent qualities of the saliva to aid coagulation.

Erzine, M. and A. Ado, 1939. AU SUJET DES VARIATIONS DE LA SÉCRÉTION DES GLANDES SALIVAIRES SOUS-MAXILLAIRES DANS LE CHOC ANAPHYLACTIQUE [On the variations of the submaxillary gland secretion in anaphylactic shock]. Bull. Biol. Med. espér. URSS, 7 (2-3): 180.

Salivary reaction to anaphylactic shock was studied in the submaxillary gland of the dog, sensitized by subcutaneous injection of a 0.1 cc./kg.-weight dose of fresh horse serum. Submaxillary gland ducts, nerves and vessels were exposed 17 to 19 days after serum injection and one gland denervated under morphine-ether anesthesia. Salivary secretion was stimulated by 1.5 cc. of 0.1% pilocarpine hydrochloride and registered on a kymograph by means of an electric drop-register. Blood pressure was measured at the femoral or the common carotid artery. The discharging serum injection was 2 cc./kg.-weight. Results show that pilocarpine salivation, after a brief initial increase in flow, ceases abruptly during severe shock for an hour to an hour and thirty minutes or more before a slow recovery to renewed secretion. A 2-4 mg. injection of pilocarpine during shock elicits no saliva but does have cardiovascular effects. Loss of the working capacity of glandular parenchyma is suggested as the cause of the absence of salivary secretion. The intact gland always stops secretion a few tenths of a second before the denervated gland and resumes post-shock secretion earlier than the denervated gland. The effect of changes in blood pressure on pilocarpine salivary secretion during the shock were studied after the abdominal aorta was ligated to sharply increase blood pressure in the carotid. Salivation from the heterolateral gland did not return after such procedure. Blood circulation in the gland is reestablished and becomes normal before salivary secretion is resumed.

Esipenko, B. E., 1954. VLIIANIE VODNOI NAGRUZKI NA PISHCHEVUIU SEKRETSIIU OKOLOUSHNYKH SLIUNNYKH ZHELEZ SOBAKI [The influence of water intake on food-stimulated secretion of the parotid

glands in the dog]. Nauch. Zapiski Kiev. Univ., 13 (14). Fiziol. Sbornik (8): 111-118. Abst.: Sovet. med. refer. Obozrenie, Fiziol., 1956 (28): 99-100.

The influence of water intake on food-elicited salivary secretion was studied in 2 dogs having fistulas of the parotid gland. Starved animals were fed every 10 to 20 minutes with a determined portion of meat-rusk powder, and given a meat broth at 37 to 40° C as liquid loading. Salivary samples were collected every 2 minutes, 8 to 10 times during the 1.5 to 2-hour test. The water intake resulted in a temporary reduction in parotid gland salivation 15 to 20 minutes after ingestion; secretion reached a minimum after 50 to 60 minutes before returning to the original salivation level 85 to 95 minutes after intake. A water intake of 250 ml. decreased the salivary secretion 4 to 5%, and the dry residue 15%, while ingestion of 500 ml. decreased salivation 8 to 10%, and the dry residue 21%.

Etherington, James W., 1934. ACIDITY IN PLAQUES. Jour. dental Res., 14 (3): 218-219.

The acidity within oral bacterial plaques was determined colorimetrically in 18 individuals. The pH of the plaques ranged from 4.6 to 6.8, while that of the unstimulated saliva simultaneously obtained varied between 6.2 and 7.2. In every instance, the pH inside the plaques was lower than that of the corresponding saliva. The plaque acidities in 11 of the caries-active cases averaged substantially the same as those of 6 caries-inactive. In one caries-active case, the acidity (pH) within the plaque ranged between 4.6 and 4.9 (in observations during two weeks); the pH of the corresponding saliva varied from 6.5 to 6.7. Mouth conditions were improved; the pH of the plaques averaged 6.3 (during observations for 3 months). Recent deterioration of mouth conditions again lowered plaque pH.

Evans, C. Lovatt, 1912. A CRITICISM OF TWO METHODS FOR THE DETERMINATION OF AMYLOCLASTIC ACTIVITY. Jour. Physiol., 44 (3): 220-224.

A comparison was made of the achromic point method and Wohlgemuth's method for determining the amylolytic power of saliva. It is concluded that the achromic point method is the more delicate and is satisfactory for detecting variations in amylolytic power. Neither method is recommended for quantitative results.

Evans, C. Lovatt, 1912a. The amylolytic property of saliva. Jour. Physiol., 44 (3): 191-202.

A study was made of the action of saliva on starch and the conditions of activity of the amylase of saliva. The effects of changes in the amount of enzyme, concentration of the substrate, temperature, pH and amount of electrolytes are included.

Evans, C. L., 1913. DER EINFLUSS DER NAHRUNG AUF DEN AMYLASEGEGHALT DES MENSCHLICHEN SPEICHEL [The effect of food on the amylase content of human saliva]. Biochem. Zeitschr., 48 (5): 432-447.

Human salivary production was studied under various circumstances. Following ingestion of food, the amylase content of the saliva increased reaching the maximum in two to three hours. This increase was probably due to the greater amount

of enzymes in the parotid saliva which made up half of the total salivary volume. When the food was only chewed but not swallowed no changes were noted in the amylase content. A meal consisting of pure protein did not increase salivary function.

Eysenck, H. J., and P. M. Yap, 1944. PAROTID GLAND SECRETION IN AFFECTIVE MENTAL DISORDERS. Jour. ment. Sci., 90 (379): 595-602.

The parotid salivation of 100 psychotic and neurotic patients was measured during conditions of reading, mental work, resting, food imagery, olfactory stimulation, and "Triple Tester" manipulation. It was determined that, during the same time periods, the secretions of anxious or depressed neurotics, or manic-depressive or melancholic psychotic patients (patients with affective disorders) were significantly less than those secretions obtained from hysterical-neurotics, schizophrenics, and other neurotics and psychotics with non-affective disorders. Men were found to salivate more than women under the test conditions.

The secretion was generally found to be decreased during periods of mental work, food imagery, manipulation of the triple tester, and olfactory stimulation (this was demonstrable in both the affective and non-affective groups).

Fabian, Gerd, and Wolfgang Lorentz, 1939. DIE SPEICHELSEKRETION BEI DER BASEDOWSCHEN KRANKHEIT MIT BEZUG AUF DIE MAGENFUNKTION [The salivary secretion in Basedow's disease with reference to gastric function]. Zeitschr. f. klin. Med., 135 (6): 692-703.

The properties of human saliva during exophthalmic goiter were investigated; the function of the gastric glands was also studied. Average salivary values (number of individuals and tests not given) were as follows (normal values in parentheses): secretion rate 0.77 cc./min (1.76); chloride concentration, 0.194 g./100 cc. NaCl (0.144); thiocyanogen concentration, 0.009 g./100 cc. (0.01); and diastatic activity, as measured by Wohlgemuth's method (cf. Wohlgemuth, 1908) 1084 units (325). No correlation could be established between the diminution in salivary amount and the gravity of the disease, nor between chlorine secretion and the production of hydrochloric acid. An increase in diastatic activity almost always accompanied an increase in chloride concentration—that is, the presence of chlorides increased the diastatic power.

Faitelberg, R. O., S. I. Ochan, and L. Portnaia, 1952. FUNKTSIIA SLIUNNYKH ZHELEZ PRI RAZDRAZHENII RECEPTOROV PLEVRY [The function of the salivary glands after stimulation of the pleural receptors]. Medich. Zhur. (Ukrain), 22 (4): 84-90. Abst.: Sovet. med. refer. Obozrenie, Fiziol., 1954 (17): 85-86.

The influence of the stimulation of pleural receptors on salivary function was studied in long-termed experimentation in 3 dogs having fistulas of the parotid gland. The receptors were stimulated by air inflation of the pleural cavity by means of an apparatus for artificial pneumothorax. Insufflation of a small volume of air (250-300 ml.) induces no significant increase in salivary secretion; a large volume of air (500 ml.) stimulates salivary secretion on initial administration. Repeated air insufflation has no uniform effect, either increasing or depressing salivary secretion.

An increase in the intrapleural pressure inhibits salivary secretion; on decrease of the pressure the secretion is restored. The author suggests that the variable salivary response to repeated pleural stimulation is due to the degree of stimulation of the pleural receptors by the intensity of the intrapleural pressure, and apparently to individual peculiarities of the animal.

Fancher, O. E., J. C. Calandra, and L. S. Fosdick, 1944. THE EFFECT OF VITAMINS ON ACID FORMATION IN SALIVA. Jour. dental Res., 23 (1): 23-29.

The effect of certain vitamins on acid formation from fermentable sugars in human saliva was studied. The acid formed was determined by its solution effect on human tooth enamel. Paraffin-stimulated saliva was divided into several 10 cc. portions, to which 1 g. of glucose and 0.1 g. of 300 mesh powdered human tooth enamel were added. The tubes were sealed, placed in a water bath, and incubated at 37°C. with constant agitation. After 4 hours of incubation the samples were removed and analyzed for dissolved calcium. The acids formed were expressed in milligrams of calcium in 100 cc. of saliva.

The action of the following vitamins in various concentrations on the acid formation was observed: beta carotene (vitamin A); thiamin chloride hydrochloride (vitamin B₁); riboflavin (vitamin B₂); pyridoxine (vitamin B₆); pantothenic acid; nicotinic acid; nicotinic amide; para-amino-benzoic acid; ascorbic acid (vitamin C); calciferol (vitamin D); alpha tocopherol (vitamin E); 2-methyl-1,4-naphthoquinone (synthetic vitamin K) and 2-methyl-3-phythyl-1,4-naphthoquinone (natural vitamin K₁); and cholesterol. In addition Cerophyl, which is prepared from grass and contains the grass juice factor, was studied.

Synthetic vitamin K and natural vitamin K₁ produced a definite decrease in the rate of acid formation. There was evidence that thiamin, nicotinic acid, Cerophyl and cholesterol may cause a slight stimulation of acid formation.

Fanning, Robert J., J. H. Shaw, and R. F. Sognnaes, 1953. SALIVARY CONTRIBUTION TO ENAMEL MATURATION AND CARIES RESISTANCE. Jour. dent. Res., 32 (5): 644-645.

The removal of the major salivary glands of 5 groups of 12 white rats each at 21, 31, 41, 51, and 61, days of age indicated a progressive decrease in caries with an increase in the length of salivary exposure of the teeth. The animals were fed a noncariogenic diet for 61 days and were then transferred to a cariogenic diet for an additional 114 days. It is suggested that saliva has an essential influence on teeth in the early post-eruptive period which makes them more resistant to external caries-producing factors.

Farmer, E. Desmond, 1953. STREPTOCOCCI OF THE MOUTH AND THEIR RELATIONSHIP TO SUBACUTE BACTERIAL ENDOCARDITIS. Proc. roy. Soc. Med., 46 (3): 201-208.

Samples were taken from the saliva and gingival sulci of 25 apparently normal individuals and cultured aerobically on blood agar. Seventy-one of the 194 strains of streptococci thus isolated and then tested as to serological type were found to belong to Lancefield groups. Groups H and K were present in the mouths of 12 individuals, F

and O in the mouths of 7, G in the mouth of 2, and B, D, and A in the mouth of 1 individual each. Members of more than one Lancefield group were often found in the same mouth. No relationship was found between oral health and the presence of these organisms. Other streptococci encountered include Str. salivarius and Str. mitis.

Examination of the mouth and blood of 4 patients with subacute bacterial endocarditis showed the presence of Group H organisms in the blood of 2. A Group H organism, of a different sub-group than that isolated from the blood, was also found in the mouth of one of these two patients. The strains isolated from the blood of patients with subacute bacterial endocarditis were found to be serologically similar to the majority of those isolated from the mouths of normal individuals.

Fantl, P., and J. Weinmann, 1935. DIE PROTEOLYTISCHE FÄHIGKEIT DES SPEICHEL. I. DIE EIGEN-PROTEOLYSE DES SPEICHEL [The proteolytic ability of the saliva. I. The auto-proteolysis of the saliva]. Biochem. Zeitschr., 281 (1-3): 37-41.

The proteinase content of human saliva was determined by measuring the residual nitrogen increase in the salivary samples covered by toluene. When the salivary samples were cooked for 15 or 30 minutes, and incubated at 37°C. for 24 hours, the residual nitrogen content was higher due to the loss of NH₃ through cooking, than in the fresh saliva. The colorimetric determination of hydrogen ion concentration was unchanged in certain cases, in others it fluctuated, either towards the acid or to the alkaline values. Willstätter's alkalimetric determination showed that when the residual nitrogen increase was more considerable, a corresponding amino acid increase also occurred.

Human saliva contributes to the decomposition of its own protein content. This auto-proteolysis is a fermentative process with little change in pH values.

The proteinase of fresh saliva originates almost completely from the components of the saliva; hardly any of the enzyme is derived from the oral flora.

Fantl, P., and J. Weinmann, 1935a. DIE PROTEOLYTISCHE FÄHIGKEIT DES SPEICHEL. II. DAS VERHALTEN MENSCHLICHEN SPEICHEL GEGENÜBER EIWISSKÖRPERN [The proteolytic ability of the saliva. II. The behavior of human saliva against protein]. Biochem. Zeitschr., 281 (1-3): 42-48.

The fermentation of protein added to the saliva was examined. In the first experiment the auto-proteolytic ability of each saliva sample was determined in order not to attribute the increase in residual nitrogen only to the extra protein added to the saliva. No increase in residual nitrogen was found after addition of denatured egg white to salivary samples. The rate of auto-proteolysis seemed to be quite irrelevant to the increase of residual nitrogen. The same results were reached when fresh egg white was precipitated with alcohol at room temperature or when fibrin was incubated with human saliva.

The comparison of incubated raw fibrin combined with saliva or with physiological saline solution indicated that less residual nitrogen was found in the saliva mixture than in the saline solution mixture. Three different preparations were tested: raw horse-fibrin in water, in phosphate solution (pH 7.3), and in physiological saline solution;

each contained residual nitrogen in various quantities after 24 hours incubation. Among the three preparations the fibrin-saline solution contained the most nitrogen residue.

The fibrin mixture (both human and equine) had a higher residual nitrogen content than saliva incubated without any admixture.

Fawcett, D. M., and S. Kirkwood, 1954. ROLE OF THE SALIVARY GLANDS IN EXTRATHYROIDAL IODINE METABOLISM. *Science*, 120 (3118): 547-548.

Diiodotyrosine, labeled with 131 , in physiological solution, was administered intravenously to rats whose parotid, submaxillary, and sublingual salivary glands had been removed. Rats with intact salivary glands and treated similarly were used as controls. Samples of blood were collected periodically and analyzed by paper chromatographic and Geiger counting techniques. Results showed that rapid deiodination of the diiodotyrosine took place in rats with intact salivary glands but not in the rats lacking these glands. The authors conclude that the salivary glands function as "reverse thyroids" and have a major role in extrathyroidal organic iodine metabolism through degradation of thyroxine and removal of the iodide ion in the saliva. The iodide reenters the blood stream via the gastrointestinal tract.

Fayle, H. D., and F. H. Scott, 1937. ABSENCE OF EFFECT OF SWALLOWED SALIVA ON COAGULATION OF BLOOD. *Proc. Soc. exper. Biol. Med.*, 35 (4): 594.

Six persons, given paraffin to chew for 15 to 30 minutes, swallowed the saliva as it was formed. Blood samples, taken every 15 minutes, indicated no effect of this procedure on blood coagulation time (obtained by the capillary tube method of Mills and Petersen). The clotting time before ingestion of saliva was 3 min. 14 sec.; one hour afterwards, it was 3 min., 15 sec.

When the salivary glands of a dog were extirpated, the blood coagulation time was still normal after several months.

When venoms (i.e., cobra and other snake venoms) were administered *per os*, the blood coagulation time was not affected.

Fedotov, G. V., and D. S. Zhilov, 1939. SEKRETORNAIA DEIATEL'NOST' PODCHELIUSTNYKH (SLIUNNYKH) ZHELEZ U LOSHADI [The secretory function of the submaxillary (salivary) gland in the horse]. *Fiziol. Zhur. SSSR*, 27 (1): 82-85.

Study was made of the submaxillary salivary secretion in the horse as compared to its parotid secretion. An 11-year old horse was fistulated for the right submaxillary and left parotid ducts by the Glinskii method. Stimulants used were 25 gm. of oats, hay, or fresh bread.

Submaxillary secretion, during chewing on the fistulated side, in response to bread was 2.3 cc.; to hay, 1.2 cc.; to oats, 1.02 cc.; during chewing on the opposite side, these figures became: 0.3 cc., 0.5 cc., and 0.6 cc. respectively.

The periods of latency are much shorter on the side of mastication than on the opposite side. The same increased secretion rate on the side of mastication was observed for the parotid gland.

A comparative table shows a completely different reaction of the parotid gland to the same stimuli: the rate of secretion on the side of mastication in response to fresh bread is 28.0 cc.; to hay, 110.0 cc.; and to oats, 47.0 cc.; on

the opposite side the respective figures are: 3.9 cc., 7.0 cc., and 0.0 cc.

Determination of the dry residue in the submaxillary saliva shows: 1.54% after bread; 2.32% after hay, 1.99% after oats, with a similar proportion in organic matter content (1.39%, 2.10%, 1.82% respectively). For the parotid saliva, the dry residue after bread is 1.49%, for hay, 2.10%, and oats 0; organic matter: 1.30%, 1.90%, and 0.

Tests on conditioned salivary secretion showed that teasing with food during 3 minutes elicits a small secretion from the submaxillary gland (0.2 cc., or 1 to 3 drops), none from the parotid.

Fedotov, I. U. P., 1954. DEISTVIE BOLEVOGO RAZDRAZHENIYA NA USLOVNYE PISHCHEVYE SLIUNOOTDELITEL'NYE REFLEKSY U SOBAK [The action of pain stimulation on conditioned salivary food-reflexes in dogs]. *Fiziol. Zhur. SSSR*, 40 (6): 673-680.

The influence of strong pain stimulation on conditioned salivary food secretion was studied in 3 dogs during 2.5 years. The dog's "v.n.d." type was determined by the following tests: 24 hours starvation, partial starvation, caffeine test, prolonged absence of the differential stimulant, altered manifestation of the conditioned reflexes, the rapidity of the production of differentiation, its completeness, stability, and the dog's behavior in the experimentation stand and outside of it. The experiments with food reflexes were done according to the Pavlov method. Conditioned salivary secretion was elicited in the following sequence: by a buzzer, a metronome at 120 strokes/min. (positive), a bell, a metronome at 60 strokes/min. (differential), a buzzer, and a bell; and consolidated by rusk and meat powder. Once in 10 or 15 days a strong pain stimulation by an alternate current at 60 to 80 volt was applied to the animal's paw during 30 seconds in another room and in the presence of different personnel, 6 to 8 minutes before the conditioned reflex experiment.

Tabulated results show that strong unconditioned pain reflexes influence conditioned food reflexes differently, depending on the v.n.d. type of the animal. The importance of the v.n.d. type is so great that in one animal the reflex secretion is increased, while in another it is inhibited. To each v.n.d. type belong definite peculiarities in the relations of coordination of the defense and food centers.

Feldberg, W., and J. A. Guimaraes, 1935. SOME OBSERVATIONS ON SALIVARY SECRETION. *Jour. Physiol.*, 85 (1): 15-36.

A description is given of experiments with submaxillary saliva in the cat and dog, repeating in part and confirming in part the work of Secker [1934, *Jour. Physiol.*, 81:81; 82:293].

Saliva obtained either by stimulation of the chorda or of the cervical sympathetic, or by injection of adrenaline produces a marked depressor effect apparently produced by a similar substance in the salivas of either animal. Parasympathetic saliva also produced a brief pressor effect. Injection of spontaneously-secreted human saliva into the cat produced vascular effects somewhat similar to those produced by injection of cat parasympathetic saliva. Studies of the nature of these substances in the rabbit and with smooth muscle tissue of the guinea pig showed the depressor principle to be neither histamine nor acetylcholine.

A trace of acetylcholine, however, may be present in chorda-stimulated saliva, induced after administration of eserine. Other experiments with atropine, and eserine in the cat failed to demonstrate the intervention of acetylcholine in transmission of sympathetic stimulation. Eserine injected in amounts too small to produce salivation by itself occasionally did increase saliva flow in response to adrenaline, but had little effect on increasing salivation in response to sympathetic stimulation in the absence of previous chorda stimulation. This effect of eserine is considered to be due to a subliminal gland excitation of the parasympathetic type.

Feldberg, W., and J. A. Guimaraes, 1935a. EFFECTS OF SYMPATHETIC IMPULSES AND ADRENALINE ON SALIVARY SECRETION. *Jour. Physiol. (London)*, 83 (4): 43P-44P.

Observations show the presence of a powerful depressor substance in cat saliva elicited by sympathetic stimulation or by adrenalin. The depressor action resulting from injection of a small dose (1 cc. of a 0.2% dilution), but not of a large dose, has a superficial similarity to that of acetylcholine but various tests show it to have properties unlike acetylcholine, choline, histamine or any other chemically identified depressant.

Feldberg, W., and J. A. Guimaraes, 1936. THE LIBERATION OF ACETYLCHOLINE BY POTASSIUM. *Jour. Physiol.*, 86 (3): 306-314.

Arterial injection of 4-10 mg. of KCl (in 0.5 cc. of NaCl-free Locke solution) into eviscerated cats (spinal, or under chloralose) had little effect on the animal's blood pressure or submaxillary gland. A similar injection, 20 to 30 minutes after intravenous injection of eserine (0.1-0.2 mg./kg.), produced a fall in blood pressure and secretion of 4 to 7 drops of saliva. Pharmacological analysis indicated the active principle to be acetylcholine.

Feirer, William A., and Veader Leonard, 1931. ORAL HYGIENE. I. THE DIURNAL TIDE OF THE BACTERIA OF THE MOUTH AND ITS USE IN DETERMINING THE ACTUAL VALUE OF PREPARATIONS COMMONLY EMPLOYED BY ORAL ANTISEPTICS. *Dental Cosmos*, 73 (3): 338-342.

The diurnal fluctuation in the number of bacteria in the salivas of three individuals was studied; the effect of three proprietary mouthwashes on this phenomenon was observed. Each of the subjects rinsed his mouth with 1000 cc. water (40 washings of 25 cc. each); organisms from the 1st, 20th and 40th washings were cultured on plain nutrient agar. The experiment was repeated and the two series of results were averaged. The numbers of aerobic bacteria in the three respective rinse periods averaged 2,788,000, 1,255,000, and 1,040,000 per cc.; staphylococci were predominant.

The diurnal tide of each individual was observed 1 minute, 1 hour, 3 hrs., 5 hrs., and 7 hrs. after the control count was taken (9 a.m.); the persons abstained from all food during the test period to prevent introduction of bacteria. A graph of the results (fig. 1, p. 339) indicates a 300% increase (average) in bacterial numbers at the end of the 7-hour period.

The effects of various dilutions of hexylresorcinol (S.T. 37) and Products A ("an amber-colored solution of essential oils, etc., in 25

per cent alcohol") and B ("a bright red, highly flavored solution containing zinc chlorid and formaldehyd") on the diurnal fluctuations were observed; the technique is described in full. Products A and B caused some reduction of the bacterial numbers, while hexylresorcinol inhibited their increase completely, and effected an average 74% reduction in all bacterial counts during the 7-hour period.

Fenu, A., 1935. TENSION SUPERFICIELLE DE LA SALIVE CHEZ LE CHIEN [Salivary surface tension in the dog]. *Rev. de Stomatol.*, 37 (11): 749.

This brief note discusses the surface tension values of submaxillary, parotid, and sublingual salivas, measured immediately after its secretion and at various periods thereafter.

Fenwick, Samuel, 1877. PRESENCE OF BILE IN THE SALIVA. *Lancet (London)*, 1877: 303-304.

An account is presented of several cases of jaundice in which a yellowish color was detected in evaporated salivary samples of the patients. In a few instances the color could be observed in the samples although the condition was considered to be alleviated. Other symptoms of liver malfunction are discussed in connection with the presence of bile in saliva.

Féré, Ch., 1894. NOTE SUR UN CAS DE SIALORRHEE EPILEPTIQUE [Note on a case of epileptic sialorrhea]. *Compt. rend. de la Soc. de Biol. (Paris)*, 46 (10): 258-259.

Study of a case of sialorrhea in an epileptic causes the author to consider the anterior part of the cerebral cortex in the vicinity of the facial centers, to be responsible for the sialorrhea.

Fernandes, J. F. and L. C. U. Junqueira, 1953. RESPIRATION, GLYCOLYSIS AND ENERGY RICH PHOSPHORUS COMPOUNDS IN SECRETING AND NON SECRETING RAT SUBMAXILLARY GLANDS. *Exper. Cell Res.*, 5 (2): 329-334.

The metabolic differences of secreting (normal) and non-secreting (ligated) submaxillary salivary glands were studied in male rats. Ligation of the glands caused a decreased O₂ production, as detected by Warburg manometry, as well as a decrease in the ATP plus ADP and creatine phosphate labile phosphorus contents. Ligation had no effect on the anerobic glycolytic processes of the gland which indicates that this reaction is not related to secretion.

Addition of succinate caused an increased O₂ production which was greater in the normal gland than in the non-secreting gland. Succinate plus malonate inhibited the oxygen uptake to the same extent in both the control and experimental glands.

It is suggested that the O₂ consumption-decrease, upon the ligation of the organs, occurred because of the relationship of respiration with the secretory process, and that the succinate and succinate plus malonate reactions resulted because of the presence of succinic dehydrogenase in cellular components (mitochondria). A marked reduction in mitochondria was noted following ligation of the submaxillary.

Ferrari, Rodolfo, and R. Höber, 1933. UNTERSUCHUNGEN ÜBER DEN DER SEKRETIONSARBEIT ZUGRUNDE LIEGENDEN STOFFWECHSEL VON LEBER, NIERE UND

SPEICHELDRÜSE [Examination of the metabolism of liver, kidney, and salivary glands as a basis of the secretory function]. Pflüger's Arch. ges. Physiol., 232 (3): 299-321.

The isolated submaxillary gland of the cat, when perfused with a hemoglobin-Ringer solution, maintained its function for a while. Stimulation of the chorda tympani resulted in salivation but at the same time lactic acid and phosphoric acid entered the vein; this process was even more marked when 1000 to 2000 molecular cyanide was injected. Following the injection of 2×10^{-5} molecular iodine acetate, salivation persisted, lactic acid production decreased, while phosphoric acid production increased at the same time. During the stimulation of the chorda, the isolated submaxillary gland secreted saliva containing a great amount of chlorine and potassium but it increased reversibly when the gland was poisoned with cyanide or iodine acetate.

Ferris, H. C., 1920. MOUTH HYGIENE, CONTROLLED BY DIET THROUGH SALIVARY ANALYSIS. Dental Cosmos, 62 (4): 453-464.

Salivary analyses in 1000 dental cases over a 10 year period indicate that when the acidity of human saliva is high, the amount of ptyalin is low. When the amount of sediment is high, acidity is also high. When the thiocyanates are very low, the ptyalin is likewise low. When the thiocyanates are high, the flow of saliva is slow and specific gravity, mucins, and solids are very high. The amount of mucin in normal resting saliva (7/40 cc. in 10 cc. of saliva) was found to be greatly increased in the presence of lesions in the mouth or in distant organs, as well as in some habitual meat eaters. Presence of albumin and globulin revealed by Esbach's reagent is an indication of pathological conditions but both are readily eliminated except in chronic kidney disease. Thiocyanates appear normally in about 1:10,000 parts, in febrile conditions in about 1:25,000, and in heart affections in as high as 1:4000 parts of saliva. Presence of diacetic acid and urea in the saliva is considered as a pathological finding resulting from faulty kidney action. "Cream" of saliva, the oily products rising to the top of the centrifuge tube, can be estimated in extreme pathological cases at 2/40 or 3/40 cc. in 10 cc. of saliva. The author's technique of salivary analyses is given.

Ferris, Henry C., 1921. THE HUMAN SALIVA AS AN INDEX OF ORAL AND CONSTITUTIONAL PATHOLOGICAL CONDITIONS. Dental Cosmos, 63 (11): 1093-1103.

Analysis of "resting" saliva, after abstinence from food for about 15 hours produced without stimulation, is correlated with a study of the diet for use as a guide to correct dietary deficiencies.

Ferris, Henry C., E. E. Smith, and E. V. Graves, 1923. PHYSIOLOGICAL AND PATHOLOGICAL VARIATIONS IN THE COMPOSITION OF HUMAN SALIVA. Jour. Amer. dental Assoc., 10 (1): 19-52.

Physiological properties of human saliva were studied under various conditions in health and in disease. Methods are fully described.

The effect of diet on saliva was studied in three subjects selected at random without regard to dental or medical pathology. Urine analyses were made simultaneously. With regard to salivary

flow, no significant change was effected by the exclusive animal diet, exclusive vegetable diet or low salt diet. The secretion rate varied from 8.2 to 16.8 cc./20 min. (aver., 12.0 cc.). However, in the high salt diet (studied in only 2 individuals), the flow was 15.0 and 17.6 cc./20 min. (aver. 16.3). The absence of a parallel between salivary flow and urinary flow was shown.—With regard to sediment, individual variations in amounts of total and organic sediment, and ash, were marked and were decidedly not a factor of the diet.—With regard to solids, only slight variations were effected by the diets. Total solids varied from 0.275% to 0.375% (aver. 0.334%) and, in the 20 minute period, from 0.0288 to 0.0571 g. (aver. 0.0426). In the urinary samples, a distinct change in the amount of solids occurred with a change in the character of the diet, amounts being high with animal food and low with vegetable diet, both in relative and absolute amounts; with the low salt diet, the solid values were relatively lower but absolutely higher; with the high salt diet, values were higher, both relatively and absolutely. These changes, in a much lesser degree, were paralleled in saliva.—With regard to chloride elimination, little change was effected by any diet save the high salt diet, where it was markedly increased. The percentage chloride of saliva for the animal, vegetable and low salt diets was 0.0739 to 0.133 (aver., 0.107%); when the high salt diet was included, values ranged from 0.0739 to 0.133 (aver. 0.111%). Comparable 20-minute determinations ranged from 0.0083 - 0.0163 (aver. 0.0126); and 0.0083 - 0.0222 (0.0142 g.) respectively.—With regard to salivary pH, that with the animal diet was 7.2; with the vegetable diet, 6.8; and that with the two salt diets, intermediary. The over-all pH average was 6.97.—With regard to carbon dioxide, the lowest values occurred during the vegetable diet and the highest on the low salt diet; these variations, however, were not constant. The percentage values ranged from 12.7 to 50.6 cc. gas/100 cc. saliva (aver. 29.7); those for 20 minutes, from 1.36 to 8.50 (aver. 3.88).—With regard to ptyalin content, highest values were obtained after the meat diet and lowest after the vegetable diet.—Determinations of total, urea, ammonia, and non-protein nitrogen were made. The total nitrogen varied from 0.0172 to 0.0337% (aver. 0.0265) and from 1.8 to 5.3 mg./20 minutes (aver. 3.5.) Urea nitrogen only occurred in 3 of 10 examinations and then in insignificant amounts. Ammonia nitrogen varied from 0.01099 to 0.023% and from 1.1 to 3.7 mg./20 min. (aver. 2.1). For non-protein nitrogen, values were 0.0129% to 0.0273% (aver. 0.0191%) and 1.3 to 3.9 mg./20 min. (aver. 2.5), respectively. No relationship between salivary and urinary values could be established.—Thiocyanate values averaged 0.0155 g./100 cc. (0.0021 g./20 min.); 0.0209 g./100 cc. (0.0023), on the vegetable diet; 0.0101 g./100 cc. (0.0023 g./20 min.), on the low salt diet; and 0.0213 g./100 cc. (0.0036 g./20 min.) on the high salt diet.

In general, the author separates the salivary constituents into two classes—those that tend to vary with the volume of secretion (i.e., inorganic solids, ash, ammonium nitrogen and chlorides) and those that tend to show a constant amount for the unit of time (organic solids, thiocyanates, and total protein on the whole).

Similar analyses were run on 8 various pathological cases; case histories are presented in detail.

Fetterly, Muriel, and George H. Maughan, 1931. THE STABILITY OF CALCIUM IN THE SALIVA AND BLOOD. Amer. Jour. Hyg., 14 (3): 723-725.

The salivas of 26 healthy college girls, receiving bi-weekly, sub-erythema ultra-violet irradiations, were studied for calcium content and for its relationship to dental decay and serum calcium. In November, irradiated girls having excellent teeth averaged 3.2 mg. Ca/100 cc. saliva, while those having poor teeth averaged 4.6 mg.; in March, values were 4.5 and 4.4 mg./100 cc., respectively. In the non-irradiated girls, November salivary calcium values for the group with excellent teeth averaged 4.1 and for those with poor teeth, 3.9 mg./100 cc.; in the March group, values were 4.6 and 3.8, respectively. These results indicate that salivary calcium is not affected by irradiation, by the condition of the teeth, nor by the season (winter). Simultaneous tests on serum calcium suggested a winter decrease in the calcium content which, however, was not affected by irradiation. No relationship between the values of salivary and serum calcium was observed.

Fickling, B. W., Paul Pincus, and Brian Boyd-Cooper, 1939. M. AND B. 693 IN THE SALIVA. Lancet (London) (2) 237: 1310-1311.

The salivas of 19 persons receiving therapeutic doses of M. and B. 693 (a sulfonamide compound) were examined for the presence of the drug. The values ranged from 0 (in 4 persons) and traces (1 person) to 26.5 mg./100 cc. saliva (1 person).

Two series of experiments on two subjects each, with oral administration of the drug, showed: (1) The saliva of the individual who merely rolled the drug-containing tablets in his mouth for two minutes without swallowing, then voiding the contents, contained 29 mg./100 cc. free M. and B. 693 within 1/2 hour and that of the individual who chewed the tablets for two minutes contained 12.0 mg./100 cc., after 7 hours. (2) In two individuals who swallowed the whole tablets without chewing or rolling them in the mouth, the saliva of one contained 1 and 0.9 mg./100 cc. M. and B. 693 after 1 and 3 hours respectively, while that of the other individual contained 0.7 and 0.6 mg./100 cc. after 1 and 3 hours respectively. In the latter experiment, the mouths were rinsed after the swallowing of the tablets to exclude the possibility of any fragments lodging in the mouth. The authors, therefore, conclude that the presence of M. and B. 693 in saliva is not attributable solely to the lodging of particles in the mouth.

Filippovich, S. I., 1938. THE ROLE OF HUMORAL STIMULI IN CHANGES OF THE REACTIVE CAPACITY OF DIGESTIVE GLANDS (SALIVARY AND PANCREAS). Communication 3. Bull. Biol. Med. exper. URSS, 6 (2): 186-189.

In a series of 40 experiments the action of adrenalin on the reactive capacity of the salivary gland [unspecified] was studied. The same method was used as in the author's experiments with chloralhydrate [Filippovich, S. I., 1938,].

The average amount of salivary secretion in response to chordal stimulation was ascertained and the composition of saliva determined 1.5 h.

after the start of stimulation; 2 to 10 cc. of adrenalin in physiological solution (0.01 to 0.1 mg./kg.) was then injected. Usually the gland reacted by a very feeble salivary secretion which continued for 2 min., after which stimulation of the chorda was resumed.

After preliminary injection of adrenalin, the gland responded to chordal stimulation, in most cases, with an increase in salivary secretion. The degree of increase depended on the amount of adrenalin injected, varying between 20 and 150 percent. The increase in salivation continued from 20 min. to 1.5 h.; it was followed by a decrease prior to restoration to the normal rate.

After repeated adrenalin injections, a brief increase in the rate of secretion was followed, in some cases, by a lengthy stage of depression; there was no restoration even after 2 to 3 hours. Very large doses of adrenalin (0.2 mg./kg.) produced at once a sharp and prolonged depression of secretion.

The chordal saliva obtained after adrenalin injection is characterized by a considerable increase in solid residue, due to an augmented content of organic matter (from 20 to 140 percent), both during the rapid and the slow rate of secretion. The increase in solid residue, as a rule, considerably exceeds the percentage of secretion decrease and continues even after restoration to a normal rate of secretion. The amount of solid residue returns to normal, usually, more than 2 to 3 hours after the injection.

To elucidate the reason for this increase in organic matter, a number of experiments were carried out with preliminary extirpation of the upper cervical ganglion. Adrenalin injections, followed by chordal stimulation, produced, first, a slight increase in salivary secretion, then a sharp depression. Sometimes the depression set in at once. The dry residue content was even more increased than in the normal gland. These facts seem to point to a direct influence of adrenalin on the functional condition of the glandular cells and to changed metabolic processes in the salivary gland due to the absence of regulating sympathetic action.

To study the influence of intravenous adrenalin injections on salivation in response to ordinary food stimuli, the same humoral stimulant was then applied in conditions of chronic experimentation. In a number of control experiments, a fistulated dog was fed 30 g. of biscuit powder every 5 min., 8 to 10 times, and the salivary samples to each portion of biscuits registered. Similar quantities of 2.5 to 3 cc. of saliva were secreted to each portion of biscuits. Beginning with the second portion, the solid residue content gradually decreased. The adrenaline injection (0.01 mg./kg.) was given after the 4th portion of biscuits. It did not change the rapidity of chordal salivary secretion, but a sharp increase in organic matter was registered after 15 min., remaining almost constant during 2 hours. On the second and third day these qualitative changes still existed in the first samples of saliva.

The author concludes that the above quantitative and qualitative changes in salivary secretion should be related to the direct influence of humoral stimuli on the functional conditions of the neuroglandular apparatus which is manifested in a change of the level of intracellular metabolism in the gland and in permeability changes of the cellular membranes.

Filippovich, S. I., 1938a. THE ROLE OF HUMORAL STIMULI IN THE CHANGES OF THE REACTION CAPACITY OF DIGESTIVE GLANDS (PANCREAS AND SALIVARY GLAND). COMMUNICATION II. Salivary gland. Bull. Biol. Méd. expér. URSS, 6 (1): 35-38.

Preliminary tests were conducted in the dog to determine the secretion rate of faradically-stimulated chordal saliva, its organic and inorganic content, and its dry residue. Tests extending over 4 to 5 hours showed 30-second stimuli, applied at 5 to 10 minute intervals, to elicit a nearly equal salivation rate which was usually exceeded only in the first two or three samples; a decrease in solid residue, due to a decrease in salivary organic matter, was noted after the second hour of test, while inorganic matter showed variable fluctuation. Intravenous injection of 0.05 to 0.2 gm./kg. body weight of chloral hydrate was followed by decreased salivation after the larger doses within the range, variable results for moderate doses, and an occasional distinct increase in flow followed by depression for small doses. Chordal salivation returned to normal flow 3 hours after large doses, 20 to 90 minutes after small to moderate doses. The percentage of dry residue increased after such injection due to an increased salivary organic content; the increase was independent of the secretion rate and persisted for a time after restoration of the salivation rate to normal. The chloral hydrate had no sialogogic effect administered alone, while injection of 0.05-1.0 mg./kg. of acetylcholine did induce salivation lasting one to 20 minutes. Subsequent chordal stimulations elicited a gradually reduced flow to each stimulus. The secretion drops to a very low level on repeated injection of acetylcholine. Chordal stimulation after cessation of acetylcholine salivation evoked an increased salivary secretion at first, followed by a decreased secretion; restoration to a normal salivation rate occurred after 40 to 60 minutes. Acetylcholine saliva had a somewhat increased content of organic matter.

Filippovich, S. I., 1939. ROL' GUMORAL'NYKH RAZDRAZHENII V IZMENENII REAKTIVNOI SPOSOBNOSTI PISHCHEVARITEL'NYKH ZHELEZ. SOOBSHCHENIE 4. VLIYANIE EMOTSIONAL'NOGO VOZBUZHDENIYA NA REAKTIVNOST' OKOLOUSHNOI SLIUNNOI ZHELEZY [The role of humoral stimulations in the change of reaction capacity of the digestive glands. Communication 4. The influence of the emotional stimulation on the reactivity of the parotid gland]. Biull. eksper. Biol. i Med., 8 (3-4): 236-238.

Previous experiments (Filippovich, 1938, 1939) have shown the influence of chloral hydrate, adrenalin and acetylcholine injections on the salivary glands of the dog. The present study endeavors to establish how the natural increase of humoral stimulants in the blood affects the reactivity of the salivary glands. Eighty experiments were made in 2 dogs with parotid fistulae. The normal standard of secretion and dry residue percentage was established during several days on the basis of repeated feeding with 30 gm. rusk powder at 15 minute intervals. After 3 to 4 feedings, a cat was presented for 10 min. as emotional stimulant, which excited a violent reaction of rage with barking and tearing. After 5 minutes, when the animal had calmed down, the feeding was resumed.

The results obtained in both dogs were analogous. The normal rate of secretion to each

portion of rusks was 3.0 to 3.5 cc. The dry residue percentage, as in previous experiments, decreases gradually at the expense of the organic matter content. The inorganic percentage does not change appreciably. After the emotional stimulation, a quantitative change occurs only in the first salivary sample, which, in most cases is increased, and an increased dry residue from organic matter in the last samples. After 20 minutes, the rate of secretion becomes normal again; the increased residue percentage, however, is observed also on the following days. The ash content either drops or shows sharp fluctuations from one sample to the other; these changes are greatest on the 2nd and 3rd day after the experiment. This discrepancy in the organic and inorganic matter proportions was observed during 10 to 15 days.

A series of experiments was also made with 0.25% hydrochloric acid stimulation. When applied after the emotional stimulation, an increase of the first salivary sample occurred only in a few cases; in all the others a rather sharp decrease took place.

These results show that under increased humoral stimulation in the blood, functional changes take place in glandular cells. These changes affect mostly the relationship between the proportions of organic and inorganic matter in the saliva and can be observed during a number of days after the humoral stimulation. The duration of these changes suggests that the influence of humoral stimulants is expressed in certain structural displacements of the glandular cells, as well as in the change of metabolism. The analysis of the mechanism is under study.

Filippovich, S. I., 1940. CHANGES IN SALIVATION UNDER THE INFLUENCE OF REDUCED BAROMETRIC PRESSURE. Bull. Biol. Med. exper. URSS, 9 (4): 338-340.

The effect of reduced atmospheric pressure on parotid salivation was studied in man and in 5 dogs having a parotid fistula. A series of 175 tests in the dog, and of 5 tests in man were conducted at simulated altitudes to 8000 m. by means of a barochamber. After-effects were observed for 5 to 10 days; control tests were conducted at normal atmospheric pressure. Canine salivation was stimulated orally for an hour at 15-minute intervals by feeding with biscuit powder or ingestion of a dilute hydrochloric acid solution, or by a subcutaneous injection of pilocarpine. The dogs made 15 "ascents" remaining in the barochamber 16 hours at 6000 or 8000 m., receiving the hourly series of stimuli at 5-hour intervals. Determinations were made of each 2-minute sample of saliva regarding the amount, organic and inorganic content, and dry residue. Human salivary samples were collected from the capped parotid duct prior to stimulation and after oral administration of a dilute citric acid solution at 15-minute intervals. Salivary determinations were made of 15-minute samples of spontaneous flow prior to the test and of each 3-minute sample of stimulated flow during two tests comprising 4 hours at 4000 m., and three tests comprising 6 hours at 8000 m. while using oxygen apparatus. Test results show an increase in spontaneous salivation in the barochamber and on the day following an "ascent"; pilocarpine evoked canine salivation in the barochamber and increased salivation on days following a test. A decreased secretion in response to oral stimulation was noted in man and dog after 6 hours at 6000 and

8000 m., persisting for 3 to 7 days thereafter; such decrease was occasionally followed by increased salivation on the second or third day after a test. A drop in salivary organic matter and dry residue was noted in food-stimulated canine saliva during and after low pressure tests; the organic matter of acid-stimulated saliva increased markedly immediately after a test then showed a decrease on the second or third day thereafter. The organic content of acid-stimulated human saliva was found augmented during and after a test. Secretory changes due to reduced atmospheric pressure are attributed to variations induced in excitability of both the central nervous system and in the salivary gland.

Filippovich, S. I., 1940a. VLIĖNIE PONIZHENNOGO BAROMETRICHESSKOGO DAVLENIĖ NA SEKRETORNIĖ DEĖATEL'NOST' SLĖNNYKH ZHELEZ [The influence of decreased atmospheric pressure on the secretory function of the salivary glands]. Arkh. biol. Nauk, Leningrad, 58 (3): 3-17.

The effect of decreased atmospheric pressure on the function of the parotid salivary gland was studied in 450 tests on 7 dogs having a parotid fistula, and in 95 tests on 2 men. Simulated ascents were made at 0.5 km./min. to 4000 m. by the humans who remained at test pressures one to 4 hours, and to 10,000 m. by the dogs which remained at the test pressures 20 minutes to 6 hours. Oxygen inhalation was supplied to the test subjects at maximum altitudes. After-effects were observed for 5 to 10 days; control tests were made at normal pressures. Salivation in man was stimulated by oral administration of 25% citric acid at 5 cc./min. for 5 minutes at 15-minute intervals; salivary samples were collected each minute during tests and for 3 minutes after test. Salivation in dogs was stimulated by injection of 1 mg. of pilocarpine, or by oral administration of either 30 mg. of rusk powder or 20 cc. of 0.25% HCl at 15 minute intervals; saliva was collected every 2 minutes during tests. Determinations were made of salivary flow, organic and inorganic matter, dry residue, diastasic activity and urate content. Test results showed short-term ascents up to an hour long to produce no salivary change or initially to increase spontaneous salivation; a 4 to 5 hour stay in the barochamber produced a marked inhibition of salivation which persisted 2 to 4 days in man, 5 to 7 days in the dog; an increase in salivation was often noted on the second or third day after descent. Ascents to 4000 m. by man resulted in an increase in salivary dry residue and often a rise in diastasic activity; dogs at 6000 to 8000 m. usually showed a decrease in salivary organic matter and an increase in urate content. Such changes were much less marked in man and nearly absent in dogs if oxygen was supplied. Repeated ascents resulted in a gradual decrease in the after-effect period, the salivary changes being noted only in the barochamber after 4 to 5 ascents; adaptation was sooner and more stable after a series of short, repeated ascents. A decrease in pilocarpine salivation in the dog under low atmospheric pressure changed to a more pronounced and prolonged increase in salivation during the after-effect period, the anoxia apparently increasing sensitivity of the glandular tissue to this stimulant. Ascents by dogs having an extirpated superior cervical ganglion produced a

sharper, more prolonged increase in salivary secretion and organic content on the operated side.

Filippovich, S. I., 1940b. IZMENENIĖ SEKRETORNOI FUNKTSII SLĖNNYKH ZHELEZ V USLOVIĖKH PONIZHENNOGO BAROMETRICHESSKOGO DAVLENIĖ [Changes in salivation under the influence of reduced barometric pressure]. Biull. eksper. Biol. i Med., 9 (4): 270-272.

Russian version of Filippovich, 1940n.

Filippovich, S. I., 1940c. IZMENENIĖ SEKRETORNOI FUNKTSII SLĖNNYKH ZHELEZ V USLOVIĖKH PONIZHENNOGO BAROMETRICHESSKOGO DAVLENIĖ [Changes in salivation under the influence of reduced barometric pressure]. Biull. eksper. Biol. Med., Moskva, 9 (4): 270-272.

Russian version of Filippovich, 1940m.

Filippovich, S. I., 1948. K VOPROSU O VLIĖNII PARASIMPATIKOTROPNYKH I SIMPATIKOTROPNYKH VESHCHESTV NA DEĖATEL'NOST' SLĖNNYKH ZHELEZ [On the influence of parasympathetic and sympathetic substances on salivary gland activity]. Biull. eksper. Biol. Med. 5: 332-334. Abstract: Sovet, med. refer. Obozrenie, 1949 (3): 64.

The influence of acetylcholine on parotid gland activity was studied in the dog. Acetylcholine was administered, 0.05 to 0.5 mg./kg.-weight intravenously or 5.0 mg./kg. subcutaneously, after determination of the normal rate of parotid salivation in response to 50 gm. of rusk powder. The injection elicited a secretion lasting 10 to 15 minutes and amounting to 3 to 5 ml. of saliva containing an insignificant organic matter content showing little albumin nitrogen. Rusk powder stimulated a somewhat larger than normal secretion when administered at the end of acetylcholine-stimulated flow; considerable variation was noted in salivary composition dependent on the time lapse after acetylcholine injection. Preliminary injection of 0.005 mg./kg. of adrenalin produced no salivation and inhibited subsequent acetylcholine stimulation; both acetylcholine-stimulated and food-stimulated salivation contained more organic matter and nitrogen after adrenalin injection.

Filippovich, S. I., 1948a. VLIĖNIE ASKORBINOVOĖ KISLOTY NA DEĖATEL'NOST' SLĖNNYKH I KISHECHNYKH ZHELEZ V USLOVIĖKH KISLORODNOGO GOLODANIĖ [The influence of ascorbic acid on the activity of the salivary and intestinal glands under conditions of hypoxemia]. Biull. eksper. Biol. Med., Moskva, 8: 99-102. Abstr.: Sovet. med. refer. Obozrenie, Fiziol., 1949 (3): 105.

Parotid salivation under conditions of hypoxemia was studied in 2 fistulated dogs and in 6 human subjects. Determinations were made of salivary flow, dry residue, urea, and amylase activity of saliva stimulated in humans by oral administration of 2.0% citric acid, and in dogs by oral administration of either rusk powder or 0.25% HCl, or by injection of pilocarpine. Tests were conducted in a barochamber with pressure adjusted to 4500 m. of altitude in 120 tests with humans and to 6000 m. in 95 tests with dogs. The reduced atmospheric pressure was found usually to decrease secretion, increase the urea content and, in humans, amylase activity of saliva. The tests showed no decrease in secretion and little increase in the urea content or amylase activity after daily administration of 300 to 400 mg. of ascorbic acid to the test

subjects for 16 to 30 days. The secretory function of intestinal glands was studied in 4 dogs having a fistulated small intestine.

Filippovich, S. I., 1948b. IZMENENIĖ DEĖATEĖĖ NOSTI SLĖUNNYKH ZHELEZ NA PISHCHEVOĖ I OTVERGAEMYĖ RAZDRAZHITEL' V USĖLOVIĖAKH PONIZHENNOGO BAROMETRICHESSKOGO DAVLENIĖA [Changes in the activity of salivary glands in response to food or chemical stimulants under conditions of low barometric pressure]. IN VLIĖANIE PONIZHENNOGO BAROMETRICHESSKOGO DAVLENIĖA NA PROTSSESSY PISHCHEVARENIĖA [The influence of low barometric pressure on the processes of digestion]. Moscow, 1948, p. 5-8. Abstr.: Sovet. med. refer. Obozrenie, Fiziol., 1949 (4): 17.

Parotid salivary response to food or to chemical stimuli was studied in fistulated dogs under conditions of low barometric pressure. Hypoxemia was found to decrease the secretion of saliva as well as its dry residue content. The change in secretion is greater and adaptation to hypoxemia more difficult if the salivary stimulant used is a chemical substance such as 0.25% HCl rather than a food such as rusk powder.

Filippovich, S. I., 1948c. VLIĖANIE VITAMINA B₁ NA DEĖATEĖĖ NOST SLĖUNNYKH I KISHECHNYKH ZHELEZ V USĖLOVIĖAKH KISLORODNOGO GOLODANIĖA [The influence of vitamin B₁ on the activity of the salivary and gastric glands under conditions of hypoxemia]. Biull. eksper. Biol. Med. Moskva, 11: 387-389. Abstr.: Sovet. med. refer. Obozrenie, Fiziol., 1950 (5): 103.

The influence of vitamin B₁ on salivary secretion was studied in 4 humans and 2 dogs under conditions of reduced atmospheric pressure. Normal salivation rates were determined before and after simulated ascents in a barochamber; the subjects then received 5 to 6 mg. of vitamin B₁ daily until saturated levels were detected in the blood and urine. A slight decrease in salivation under conditions of hypoxemia, as well as an absence of salivary adaptive effects after 9 to 13 days, was found in humans after establishment of the B₁ saturation. No changes were noted in canine intestinal glands under similar experimental conditions.

Filippovich, S. I., 1948d. VLIĖANIE SISTEMATICHESKOĖ TRENIROVKI V BAROKAMERE NA IZMENENIE DEĖATEĖĖ NOSTI SLĖUNNYKH ZHELEZ V USĖLOVIĖAKH PONIZHENNOGO BAROMETRICHESSKOGO DAVLENIĖA [The influence of systematic training in the barochamber on the change in activity of the salivary glands under conditions of lowered barometric pressure]. In: VLIĖANIE PONIZHENNOGO BAROMETRICHESSKOGO DAVLENIĖA NA PROTSSESSY PISHCHEVARENIĖA [The influence of lowered atmospheric pressure on the processes of digestion]. Moscow, 1948, p. 10-18. Abstr.: Sovet. med. refer. Obozrenie, Fiziol., 1949 (4): 18.

Human and canine parotid salivation was studied under conditions of a series of one-hour tests in a barochamber at low atmospheric pressure. Tests were conducted with humans at a pressure equivalent to 4000 m. of altitude, and with dogs at 6000 m.; dilute hydrochloric acid or rusk powder were used as salivary stimulants. The systematic training resulted in an adaptation of parotid gland activity to low atmospheric pressure by both men and dogs. This adaptation

occurred sooner using the rusk powder stimulant than the acid solution. Excision of the superior cervical sympathetic ganglion considerably lengthened the training period required to obtain adaptation. The paralytic salivary secretion which followed excision of the tympanic nerve and the ganglion was sharply inhibited by the low pressure atmospheric. The results indicate the important role of humoral factors in salivary secretion during hypoxemia.

Finch, Glen, 1938. HUNGER AS A DETERMINANT OF CONDITIONAL AND UNCONDITIONAL SALIVARY RESPONSE MAGNITUDE. Amer. Jour. Physiol., 123 (2): 379-382.

A series of experiments on the role of conditioned and unconditioned hunger responses in six dogs indicated:

"1. Food deprivation affects both the conditional and unconditional salivary responses in relatively the same way: volume of salivary secretion increases from minimal at 0-hour's deprivation (food satiation) to maximal at 72-hours; at 96-hours the volume of secretion falls to near the 24-hour level.

"2. The coincidence of minimal secretion with minimal hunger and of maximal secretion with near maximal hunger indicates that the strength of the 'drive' stimulus is an important determinant of CR [conditioned reflex] and UCR [unconditioned reflex] magnitude." (Author's conclusions.)

Finch, Glen, 1938a. SALIVARY CONDITIONING IN ATROPINIZED DOGS. Amer. Jour. Physiol., 124 (1): 136-141.

Parotid fistulae were prepared in two dogs. On recovery, the animals were placed in a conditional response apparatus described elsewhere (Wolff et al., 1935m). Preliminary observations consisted of 10 daily measurements of parotid secretion rate (30 min.) with animals held in the apparatus but not otherwise stimulated; and 5 daily 30-min. parotid secretions collected after dogs had been given 1 ml. subcutaneous injections of normal saline solution 15 min. after being placed in the apparatus. After completion of these observations, 1 ml. aqueous solution of 10 mg. atropine sulfate was substituted for the saline solution.

It was concluded that:

"1. Daily subcutaneous injections of 10 mgm. atropine sulphate (2 dogs) resulted in a progressive heightening of the pre-injection parotid salivary secretion.

"2. Conditional salivary responses were not established in one atropinized dog during training when food was presented as the unconditional stimulus. This failure may be attributed to the animal's refusal to ingest food.

"3. Conditional salivary responses were readily established in two atropinized dogs when dilute hydrochloric acid was injected in the mouth as the unconditional stimulus. Conditioning thus established underwent experimental extinction and exhibited 'spontaneous recovery.'" (Author's conclusions.)

Findlay, G. M., and L. P. Clarke, 1934. THE EXPERIMENTAL PRODUCTION OF MUMPS IN MONKEYS. Brit. Jour. exper. Pathol., 15 (5): 309-313.

Histological changes comparable to those seen in human mumps were produced in Rhesus monkeys by inoculation with human mumps-infected saliva.

Bacteriologically sterile salivas, collected within 48 hours after onset of parotitis and filtered (British Berkefeld), proved infective when injected into Stenson's duct of the animals; however, saliva collected 72 hours after onset of the disease was not infective, indicating that mumps saliva may lose its virulence at a very early stage.

Finesinger, Jacob E., and G. L. Finesinger, 1937. A MODIFICATION OF THE KRASNOGORSKI METHOD FOR STIMULATING AND MEASURING THE SECRETION FROM THE PAROTID GLANDS IN HUMAN BEINGS. *Jour. Lab. clin. Med.*, 23 (3): 267-273.

A complete description is given of a method for stimulating, measuring, and recording the secretion of the parotid glands. The method is a modification of the Krasnogorski (1931) method. The modifications include the use of lemon juice administered through tubes held in the subject's mouth, a simpler suction apparatus, and a device for obtaining greater accuracy in recording the secretion.

Fish, E. Wilfred, and I. H. Maclean, 1934. IMMUNITY TO THE ORGANISMS OF DENTAL CARIES. *Dental Cosmos*, 76 (8): 837-841.

Streptococcus mutans was found to disappear from 17 human teeth 3 to 4 days after carious teeth containing these organisms had been transplanted into the mouths of dogs. When 4 similar teeth were implanted in the mouth of a monkey, *S. mutans* was recovered after 11 days in the carious lesions of the monkey's own teeth. At no time was the organism recovered from the monkey's saliva.

Seven carious human teeth were incubated at 37°C for 1 to 8 days in saliva collected from mouths found resistant to dental caries. The saliva was changed daily. *S. mutans* was not recovered after 2 days of incubation, nor *S. viridans* [*S. mitis*] after 7 days of incubation. It is suggested that incidence of dental caries depends on the susceptibility of the patient to the organism concerned, while arrest of caries is apparently due to a change in environment of the tooth rather than to resistance on the part of the dentin.

Fischer, Edward H., and J. Fellig, 1952. SALIVARY AMYLASE INHIBITION SCIENCE, 115 (2999): 684-685.

A study was made of the inhibition of the amylase activity of crude human saliva and of crystalline human salivary alpha amylase by tryptophane, proline, nicotinic acid, beta indole acetic acid, beta indole propionic acid, alpha naphthalene acetic acid and 1-4 dichlorophenoxyacetic acid in concentrations ranging from 0.01 to 0.0001 M. No inhibition of human amylase by the indole derivatives or plant hormones mentioned was noted.

Fischl, E., and R. H. Kahn, 1930. DIE AMYLOLYTISCHE WIRKSAMKEIT DES KANINCHENSPEICHEL [The amylolytic activity of rabbit saliva]. *Pfluger's Arch. ges. Physiol.*, 225 (5-6): 694-695.

The injection of 1-2 drops of 2% pilocarpine into the conjunctiva of the rabbit was followed by profuse salivary secretion and by a considerable saccharification of the saliva. When the amylolytic function of human and rabbit saliva were compared according to Wohlgemuth's and

Biedermann's spot method, the results obtained were very similar. The weight and sex of the animal did not have any bearing on the amylolytic function. The fluctuation of the values was as frequent in the human as in the rabbit saliva.

The extirpation of the submaxillary and sublingual salivary glands of the rabbit did not have any effect on the pilocarpine-saliva secretion. With the extirpation of both parotid glands, however, a complete dysfunction of the saliva secretion was seen.

In fasting rabbits the amylolytic function increased considerably on the first day, to be followed by a marked decrease terminating in the full discontinuance of this function. The fluctuation in the amylolytic function of the rabbit showed parallel values with the dry substance content of the saliva.

Fischmann, E. J., and A. Fischman, 1948. THE THIOCYANATE CONTENT OF SALIVA IN NORMAL AND HYPERTENSIVE SUBJECTS BEFORE AND AFTER INGESTION OF THE DRUG. *Jour. Lab. clin. Med.*, 33 (6): 772-776.

A study was made of the salivary thiocyanate content of 35 healthy subjects, 35 patients with raised blood pressure before treatment with the drug, and 30 patients with raised blood pressure during treatment with thiocyanate salts. One hundred and forty determinations were made before and 176 after the administration of KSCN. The mean concentrations for naturally-occurring SCN in normal subjects and in hypertensive subjects were found to coincide closely and no significant differences were noted. A comparison of the concentration with the rate of flow of saliva indicated that concentrations expressed as mg. percent are inversely proportional to the rate of flow while mg. per hour show an increase with a higher rate of flow.

Concentrations of SCN in the saliva after ingestion of KSCN were found to be greater than in the serum of the patient. An inverse relationship was noted between the naturally occurring amounts of SCN and the additional amounts observed after ingestion of the drug. This tendency has a leveling effect on the total concentration observed, obscuring changes due to change in dosage.

Fitch, C. P., W. L. Boyd, and Lucille M. Bishop, 1939. STUDIES ON SALIVA AND SALIVARY GLANDS FOR THE PRESENCE OF BRUCELLA ABORTUS. *Cornell Veterinarian*, 29 (3): 338-340.

The salivas or the submaxillary and parotid glands of 75 bovine animals which gave definite indications of Bang's infection in the agglutination test, were examined for the presence of *Brucella abortus*. None of the cultures of 134 stimulated (injections of 1 g. pilocarpine sulfate) saliva samples from 39 cattle, nor the submaxillary and parotid glands from 36 other animals were positive for the organism. However, *B. abortus* was isolated from one of the salivas by guinea pig inoculation; the samples had been obtained from a cow which had calved 11 days previously. The possibility of contamination from outside sources is noted. The authors conclude from the foregoing data that "saliva is not an important source of elimination of *B. abortus* from the animal body."

Fitzgerald, Robert J., Helmut A. Zander, and Harold V. Jordan, 1950. THE EFFECTS OF PENICILLIN DENTRIFRICE ON ORAL LACTOBACILLI. *Jour. Amer. dental Assoc.*, 41 (1): 62-65.

Salivary lactobacillus counts on tomato juice agar with and without added penicillin were performed on a control group of children and an experimental group using a penicillin-containing dentifrice to determine the incidence of penicillin-fast lactobacilli. In June, 1949, using tomato-juice agar plates containing 1.0, 10, and 50 units of penicillin per ml. of medium, the incidence of positive plates for the lowest penicillin concentration was 14 per cent of 129 control children and 22 per cent of 181 cases in the experimental group. At this time the dentifrice had been in use for 1 year and a half. None of the plates containing higher concentrations of penicillin gave positive cultures for lactobacilli. Six months later the incidence of positive plates containing 1 unit penicillin per ml. of medium was 24 per cent and 27 per cent, respectively, for the control and experimental groups. Under the experimental conditions employed, these differences could not be considered significant. (Author's abstract)

Fitzgerald, Robert J., 1952. PRELIMINARY STUDIES ON THE PRESENCE OF ACID PHOSPHATASE IN CERTAIN ORAL MICROORGANISMS. Jour. dental Res., 31 (2): 189-194.

Paraffin-stimulated salivas and some salivary microbes of 30 adults (20-35 years of age) were examined for phosphatase activity; method is fully described and, considering the possibility of using this test as an indicator of caries activity, results were compared with those obtained by two tests generally accepted when testing for caries activity---the Snyder test and the Lactobacillus acidophilus count.

In general, phosphatase activity was varied, but agreed closely with that determined for the respective samples by the other two tests, indicating the probable suitability of this method in testing for caries activity.

Approximately 200 cultural studies of salivary microbes showed lactobacilli, streptococci, and micrococci to have acid phosphatase activity, as did a group of Gram-negative rods resembling Aerobacter aerogenes.

Fitzgerald, R. J., H. V. Jordan, and I. Zipkin, 1953. STUDIES ON RAT ORAL LACTOBACILLI. Jour. dent. Res., 32 (5): 645-646.

Study of the oral flora of the white rat has indicated a lack of a relationship between oral lactobacilli and caries. The types of lactobacilli of the white rat are found to differ from those found in the human oral cavity in several biochemical and nutritional characteristics.

Fleming, Alexander, and V. D. Allison, 1922. OBSERVATIONS ON A BACTERIOLYTIC SUBSTANCE ("LYSOZYME") FOUND IN SECRETIONS AND TISSUES. Brit. Jour. exper. Pathol., 3 (5): 252-260.

Biochemical studies showed that lysozyme, a bacteriolytic substance present "in human secretions and tissues (with few exceptions), as well as in animal and some vegetable tissues" has the following properties: It is a very stable substance, enduring storage and desiccation for many weeks; is water soluble but insoluble in ether, alcohol, acetone, toluene, or xylene; is inhibited by the presence of high concentrations of salt but activated slightly by salt concentrations of 0.5%; is partially or completely inhibited by small amounts

of either acid or alkali; and is destroyed rapidly at 70° C. (in saliva) and in 10 min. at 75° C. (in sputum, nasal mucus, and cartilage). It lyses both living and dead cells, and is active over a temperature range of 4 to 65° C.

Lysozyme-resistant strains of organisms may be developed showing the same resistance to lysozymes from various sources.

Fleming, Alexander, 1922a. ON A REMARKABLE BACTERIOLYTIC ELEMENT FOUND IN TISSUES AND SECRETIONS. Proc. roy. Soc. (London), (B) 93 (653): 306-317, pl. 9.

The action of various tissues and body fluids of man on bacteria (Micrococcus lysodeikticus, and others) was studied. The presence of a bacteriolytic substance, named lysozyme by the author, is demonstrated (disproving Metschnikoff's statement that the secretions of the body wash microbes away mechanically). The solubility, resistance to drying, effects of temperature, bactericidal and lytic action of the substance are discussed. The lysozyme content of saliva varies considerably. In general, it is very low compared with that of tears, sputum, and nasal mucus.

Fleming, Alexander, 1929. ARRIS AND GALE LECTURE ON LYSOZYME, A BACTERIOLYTIC FERMENT FOUND NORMALLY IN TISSUES AND SECRETIONS. Lancet (London), 216 (5501): 217-220.

A study was made of the distribution and concentration of lysozyme in man, plants, and animals. In the human body lysozyme was found widely distributed in a great variety of tissues and secretions. Using Micrococcus lysodeikticus as the test organism, saliva was found to contain lysozyme in as high a dilution as 1:300 as compared with a 1:270 dilution for blood serum, 1:40,000 for tears, 1:13,500 for nasal mucous, and 1:13,500 for sputum.

The nature of lysozyme, its action on different bacteria, the production of resistant strains, "absorption" of lysozyme by sensitive bacteria, and its relation to natural immunity are discussed.

Fleming, Alexander, 1932. LYSOZYME. Proc. roy. Soc. Med., 26 (2), sect. Pathol.: 71-84.

A review is presented on research with lysozyme concerning its enzymatic properties, its distribution in nature, and its importance in immunity. The substance is contained in all human body tissues to a greater or lesser extent, and in many body fluids. It has been found to have great potency in sputum (a dilution of 1/13,500 completely lyses Micrococcus lysodeikticus in 1 hr. at 45°C) and moderate potency in saliva (highest effective dilution 1/300). A test of 1% extracts of lysozyme from tissues of various animals showed the lowest dilution of a salivary gland extract lysing a test organism to be 1/256 in the cat, 1/128 in the guinea pig, 1/32 in the rabbit, 1/512 in the dog, and in excess of 1/1024 in man.

Fletcher, H. M., 1901. THE TONGUE AS A BREEDING PLACE FOR BACTERIA. Jour. Amer. med. Assoc., 37 (3): 170-171.

The tongue is a breeding place for bacteria with mucus, normal saliva, dead epithelium, particles of food, and exudations from diseased gums serving as media.

Florestano, H. J., J. E. Faber, and L. H. James, 1941a. STUDIES OF THE EFFECT OF INGESTION OF CITRUS

FRUIT ON THE ORAL MICROBIAL FLORA. Jour. dental Res., 20 (6): 521-532.

The effect of ingestion of citrus fruit on the oral microbial flora was studied in 131 inmates of a penal farm (67 as a test group and 64 as controls). All persons received regular prison diets. In addition, the test group was served 1/2 of a grapefruit with each of the 3 daily meals for 6 months. Paraffin-stimulated saliva samples (25 cc. each) were collected monthly and cultured; bacterial counts were made. After one month, a 47% reduction in oral microorganisms was observed in the test group; this reduction was maintained as long as the diets were supplemented with grapefruit.

Inhibition of microbial growth effected by local application of citrus fruit was studied in a previous paper (cf. Florestano, 1941).

Results of both studies indicate the presence of a factor, or factors, in citrus fruit inhibitory to oral microorganisms. The author emphasizes the importance of citrus fruit in the reduction of both pathogenic and aciduric microorganisms in the control of certain oral diseases.

Florestano, H. J., J. E. Faber, and L. H. James, 1941. STUDIES ON THE RELATIONSHIP BETWEEN DIASTATIC ACTIVITY OF SALIVA AND INCIDENCE OF DENTAL CARIES. Jour. Amer. dental Assoc., 28 (11): 1799-1803

The salivas of 166 persons (76 non-carious and 90 carious) were examined for diastatic activity. The starch-iodine method, fully described, was used. A direct correlation was established between caries incidence and the diastatic activity. In 28 individuals having rampant caries, the average diastatic index was three times that of the caries-free individuals. The use of the salivary diastatic activity as an index for caries activity is suggested.

Florestano, H. J., 1941b. EFFECT OF CITRUS FRUIT DIET ON THE ORAL FLORA. Jour. Bacteriol., 42 (1): 149.

"One hundred and thirty-one men in the District of Columbia Penal Farm, Lorton, Virginia, were divided into two groups. All received the regular prison diet. In addition, each man in one group (67 men) received one-half of a grapefruit three times daily. The other group served as a control.

"The oral flora was determined by plating samples of saliva in (1) plain nutrient agar for the total number of saprophytic bacteria, (2) tomato juice agar for aciduric organisms, and (3) blood agar for organisms requiring animal protein for growth. Examinations of the saliva of each man of both groups was made preceding the feeding of grapefruit and subsequently once a month for 6 months.

"The oral microbial count of three-fourths or more of those receiving grapefruit was decreased, the average being 47 percent after one month. Reduction was maintained throughout the test period. Decrease apparently was due more to local influences of citrus fruit than to systemic involvement.

"Marked reduction of both pathogenic and aciduric organisms of the mouth through ingestion of citrus fruit may be an important factor in the control of certain oral diseases." (Complete paper.)

Florestano, J. J., Myron A. Elliott, and J. E. Faber, Jr., 1941c. THE EFFECT OF CITRUS JUICES AND VARIOUS MOUTH PROPHYLAXES ON THE ORAL FLORA AND SALIVA. Jour. Bacteriol., 41 (5): 605-625.

A brief review is presented of the work of previous authors on the bacterial flora of the oral cavity and the effects of anti-bacterial substances.

The author tested, on 9 subjects, the effectiveness of six substances as oral prophylactic agents: sterile distilled water, grapefruit juice, orange juice, Product A (tooth paste and mouth wash containing hexylresorcinol), Product B (tooth paste and mouth wash containing sodium ricinoleate), and Product C (liquid dentifrice containing a long chain sodium alkyl sulfate).

Paraffin-stimulated saliva samples (approximately 25 ml. each) were collected before and after lunch, and two hours later; the samples were cultured and counts averaged. A comparison was made between these and the counts taken after prophylactic treatment (brushing of teeth for 2 minutes followed by a 1-minute rinse with 30 ml. of the respective mouth washes).

pH determinations were made by means of vacuum tube potentiometer and glass electrode; buffer capacity and surface tension were also determined. Taking counts after lunch before prophylaxis as a 100% basis, Products B and C showed the greatest percentage decrease in microorganisms (Product B, 89.2%, and Product C, 85.7%). Orange juice or water only effected a 46.7% decrease.

While Products B and C were the most effective in the removal of microorganisms, citrus juices were the more inhibitory at the end of 2 hours following prophylactic treatment. The percentage microbial increase for orange juice was 169.8%, and for grapefruit, 205.1%, while for water and Products A, B, and C, it was 268.5%, 313.4%, 687.1%, and 331.3% respectively.

Six hundred and six pH determinations showed no significant change effected by either orange or grapefruit juice; Products A, B, and C produced a 0.4 to 0.8 increase in salivary pH which was still apparent 2 hours after prophylaxis.

In a similar number of buffer-capacity determinations, the citric juices produced a temporary increase; that of orange juice was 0.3×10^{-3} , of grapefruit, 0.6×10^{-3} . A large temporary rise (2.8×10^{-3}) accompanied by a rise in pH (0.8) in the same saliva occurred when Product B was employed; this occurrence may possibly be attributed to the retention in the mouth of some of the solid alkaline buffering material in the product.

Orange juice and Product B were studied to determine the length of time that the rise in buffer value of saliva lasted after the prophylactic treatment; in both cases, the increase disappeared within one-half hour after prophylaxis.

In surface tension studies, orange juice effected no significant change while Products B and

C produced a 14 and 15% lowering respectively, 5 minutes after treatment. In general, it appeared that those agents that produced the greater lowering of salivary surface tension were the more effective in removing bacteria from the oral cavity, but were less effective in restraining the growth of the remaining bacteria.

Florestano, H. J., 1942. ACIDOGENIC PROPERTIES OF CERTAIN ORAL MICRO-ORGANISMS. Jour. dental Res., 21 (3): 263-268.

A study was made of the acidogenic agents of the salivas of 237 individuals (136 carious and 101 non-carious), and their relation to dental decay was considered. Approximately 25 cc. of paraffin-stimulated saliva were collected from each subject about 2 hours after breakfast; organisms were isolated, cultured, and their acidogenic properties measured by means of a glass electrode pH meter (method is described in full).

The acidogenic powers of 242 cultures of salivary microorganisms (including Gram-positive rods, streptococci, staphylococci, and yeasts) were determined. The S form of lactobacilli produced a much lower pH than did the R form. Of 121 strains of the S form, 77 produced a pH of 4.0 to 3.4 after 7 days incubation and 44 strains, a pH between 4.9 and 4.1; of the 14 R strains of salivary lactobacilli, none produced a pH below 5.25.

Sixty-eight strains of streptococci were isolated; 39 produced a pH of 4.0 to 3.4.

Ten of 25 strains of staphylococci produced a pH of 4.0 to 3.7.

The acidogenic powers of 14 strains of yeast tested were relatively slight, the lowest pH produced being 5.17.

It appears that oral streptococci and staphylococci may be as acidogenic as lactobacilli, or more so. The lowest pH produced by lactobacilli was 3.6; the lowest for staphylococci, 3.7; and for streptococci, the lowest was 3.4.

No correlation could be established between the amount of acid produced by oral microorganisms and the presence or absence of dental decay. Acidogenic types were as prevalent in caries-free individuals as in immunes.

Florey, Howard, 1930. THE RELATIVE AMOUNTS OF LYSOZYME PRESENT IN THE TISSUES OF SOME MAMMALS. Brit. Jour. exper. Pathol., 11 (4): 251-261.

The lysozyme content of various tissues, including those of the salivary gland, was determined in 6 mammalian species. Results show that rat saliva at a 1:40 dilution, and guinea pig saliva at a 1:10 dilution produced one-fourth lysis of a standard test organism, Micrococcus lysodeikticus.

Fog-Muller, B. I., 1935. EINIGE UNTERSUCHUNGEN ÜBER DIE AUSSCHIEDUNG VON BLUTGRUPPEN-SUBSTANZ (ANTIGEN) IM VENTRIKELSEKRET UND SPEICHEL, SPEZIELL BEI PERNIZIÖSER ANÄMIE [Some investigations on the elimination of blood group substance (antigen) in ventricular secretion and saliva, especially in pernicious anemia]. Zeitschr. f. Immunitätsforsch., 84 (5/6): 359-363.

Experiments on 28 persons with pernicious anemia and other maladies (achylia gastrica, hyperchylia, etc.) indicated that the antigen content (A₁, B, and O) in the saliva did not differ from normal controls.

Fol'bort, G. V., and A. T. Ryskal'chuk, 1925. O VLIĖNIĖ SKOROSTI SEKRETSII SLIUNY NA EE SOSTAV V KHRONICHESKOM OPYTE. BESEDA [On the influence of the rapidity of salivary secretion on its composition in the long-termed experiment. Short report]. Fiziol. Zhur., SSSR, 8 (314): 96-97.

A study was made in 2 dogs to determine whether, in chronic long-termed experimentation, each change in salivary secretion would necessarily be followed by an increase of the dry residue amount. Stimulants used were bread of varied dryness and 0.25 or 0.5% hydrochloric acid. After establishing the normal secretion level in the unit of time, either triple quantities of the stimuli were given, or the concentrations of the same quantities were increased (completely dried bread, 0.5% HCl).

All the results showed that a greater quantity of the stimuli produces parallel with an increased secretion, an increased dry residue; with a greater concentration of the stimuli, however, there is augmented secretion accompanied by a decrease in the dry residue.

Fol'bort (Volborth), G. V., and A. T. Ryskal'chuk, 1925a. O VLIĖNIĖ SKOROSTI SEKRETSII NA SOSTAV SLIUNY V KHRONICHESKOM OPYTE [On the influence of the rapidity of salivary secretion on the composition of saliva in the chronic experiment]. Fiziol. Zhur. SSSR, 8 (5-6): 167-177.

Study was made on the dry residue of saliva to determine the influence of fluctuations in the rapidity of salivary secretion in response to various quantities of rye bread (ordinary weight or dried to 50%) or solutions of hydrochloric acid (0.25, or 0.5%) given by mouth to three dogs with chronic parotid and submaxillary fistulae over a period of 3 min. After establishing the normal secretion level and allowing a rest period of 15 to 30 min., increased salivation was stimulated by doubling or tripling the quantity of bread or acid, or by doubling the concentration (dried bread to 50%, 0.5% HCl).

The results are detailed in four tables. There is a sharp difference in the amounts of organic matter and ash under the influence of more rapid secretion. The ash content fluctuates parallel with the secretion rate, which confirms earlier findings that an increase in the rapidity of secretion is followed by an increase in ash content (Heidenhain, 1872, 1878). The amount of organic substance, however, fluctuates in two different directions depending on the cause which produced the increase in salivation: it is increased with the quantity of the stimulating substance, but decreased with an augmented concentration of this substance.

Thus, Heidenhain's rule is applicable to the ash content only. The organic amount does not depend on the rapidity of secretion (contrary to Heidenhain), but is the result of a complicated reflex which is regulated by the central nervous system.

Fol'bort, G. V., 1934. PROTSESSY ISTOSHCHENIĖ I VOSSSTANOVLENIĖ I IKH VZAIMNYE OTNOSHENIĖ [The processes of exhaustion and restoration and their correlation]. Priroda, 10: 43-50.

The dynamics of the processes of exhaustion and restoration were studied in the fistulated parotid and submaxillary glands of 20 dogs, in chronic experimentation. Uninterrupted and abundant salivation, resulting in the exhaustion of the gland after 2 to 3 hours, was obtained by

feeding the dogs 1 gr.-pieces of rusk every 15 to 20 sec.

A gland weighing 5 to 8 gr. secretes 150 to 250 cc. of saliva under these circumstances. With the duration of salivation the [dry residue] concentration decreases to 40 to 45% of its normal standard. Special experiments, made in the author's laboratory, verified the fact that the decreases in salivary concentration under the above circumstances is due to glandular exhaustion only, and not to chemical changes taking place in the animal's body. Only the organic matter in salivary secretion is subject to decrease by glandular exhaustion; no such changes can be attributed to the salt or water content.

A period of 5 to 6 days is necessary for complete restoration of salivary secretion after exhaustion. The rapidity of restoration depends on the intensity of work which resulted in the gland's exhaustion. If the work which leads to the exhaustion of the gland is very intensive, i.e. after feeding the dog 15 to 20 pieces of rusk per minute instead of 4, the salivary secretion per minute is more intense, but the dog refuses its food after 30 to 40 min. and the total amount of saliva is 100 to 150 cc.; the drop in concentration is greater, reaching 30 to 35% of its normal standard. Yet the secretion will be restored to normal on the 3rd or 4th day.

Thus, glandular restoration to normal is stimulated not so much by the process of exhaustion itself, as by the rapidity with which this exhaustion has been produced, i.e. by the rapidity of chemical changes in the gland. Bioptic tests made in the author's laboratory with intestine prepared after the Magnus method illustrated the importance of this rapidity factor in chemical changes.

Fol'bort, G. V., 1936. PROTSESSY ISTOSHCHENIYA I VOSSTANOVLENIYA PO OPYTAM NA SLIUNNYKH ZHELEZAKH. [The processes of exhaustion and restoration in experiments with salivary glands]. Fiziol. Zhur. SSSR, 21: 979.

The author's investigations are reviewed concerning changes in submaxillary and sublingual saliva elicited by exhaustive salivary gland stimulation of fistulated dogs. Results showed that five to six days were usually required for a return to normal salivary function after periods of such stimulation. The length of the restoration period was affected by the intensity level of glandular activity and by the length of the interval between exhaustive tests. The restoration period was short after rapid exhaustion produced by a high rate of glandular activity. Glandular adaptation, characterized by lesser exhaustion and faster recovery, was produced by a series of exhaustion tests conducted at intervals permitting normal recovery between the tests. The return to normal salivation was retarded if exhaustion was produced by prolonged secretion at a low level of glandular activity, or if rapid exhaustion tests were conducted at intervals too short to permit normal inter-test recovery. Secretory fluctuations were noted during the recovery period, similar to those occurring during daily, non-exhausting glandular activity.

Fol'bort, G. V., and V. K. Zol'nikova, 1940. PROTSESSY ISTOSHCHENIYA I VOSSTANOVLENIYA PRI SLABOI I PRI INTENSIVNOI DEIATEL'NOSTI SLIUNNYKH

ZHELEZ [Processes of exhaustion and restoration in low and intensive activity of the salivary glands]. Fiziol. Zhur. SSSR, 29 (12): 481-489.

Further study was made of the course of exhaustion and restoration after short intensive activity in the fistulated parotid and submaxillary glands of the dog. The concentration of general salivary nitrogen content at determined rates of secretion served as indicator of the functional activity of the salivary glands. The nitrogen content was determined by the micro-Kjeldahl method, modified by Bang. The normal standard was established from samples collected after feeding the dogs four 1-gm.-pieces of rusk per minute during 5 to 7 minutes, three times, with 5 min. intervals. The nitrogen content was found to be fairly constant, averaging 43.49 mg. per sample (1 to 3 cc. of saliva).

To obtain the exhaustion of the salivary gland, the same feeding was continued without interruption for 1.5 to 2.5 hours, until the dog refused the food. Fifty to 150 cc. of saliva were thus collected, averaging 0.9 cc./min.

To obtain more rapid exhaustion, 20 to 24 pieces of rusk were fed per minute, which the dog would refuse after 15 to 25 min. About 50 cc. of saliva were collected during this time, averaging 2.5 cc./min.

Comparative results are tabulated. They show that the duration of slow salivation is six times greater than that of intensive salivation. The amount of nitrogen contained in saliva at the point of secretory exhaustion is insignificant (Zol'nikova, 1938), or absent (Aleksentseva and Fol'bort, 1938) in both the slow and the rapid exhaustion.

As stated elsewhere (Fol'bort, 1934, 1935), secretory restoration is much quicker after rapid than after slow exhaustion. A characteristic feature of the restoration process after rapid exhaustion is the appearance of a normal amount of nitrogen in the first sample taken on the three days subsequent to the exhaustion test, dropping sharply in the second and third samples. On the 4th day, the gland resumes its normal activity. After exhaustion by prolonged, weak secretion, restoration to the normal nitrogen content is more gradual, normal activity of the gland being resumed after the 5th day.

These results show that the same loss in functional capacity is suffered by the salivary secretory system after a short, intensive, as after a prolonged, sluggish work. Functional loss depends, therefore, more on the intensity of the work performed than on its duration. Stabilization of restoration is a slower process than the quantitative restoration proper.

Fol'bort, G. V., and N. K. Zol'nikova, 1946. LOKALIZATSIYA PROTSESSA ISTOSHCHENIYA V REFLEKTORNOI DUGE PRI DLITEL'NOI DEIATEL'NOSTI [Localization of the process of exhaustion in the reflex arc during prolonged activity]. Vracheb. Delo, 1946, (1-2): 1-11.

Severe experiments were conducted in the dog to localize exhaustion processes in the reflex arc during prolonged reflex stimulation of the submaxillary gland. A decreasing percentage of salivary nitrogen in successive salivary samples indicated glandular exhaustion. Humoral stimulation was applied to submaxillary gland tissue by injection of acetylcholine into the gland artery; the

cerebral salivary center was stimulated by increasing the carbon dioxide concentration in the blood. Two to three hour periods of moderate faradic stimulation were administered, during the 15- to 17-hour experiment, to successive sections of the reflex arc in sequence as traversed by the neural impulse. Fundamental changes were found in all sections of the reflex arc; the process of neural response to a stimulus showed the most rapid exhaustion.

Fol'bort, G. V., 1948. EKSPERIMENTAL'NOE OBOSNOVANIE VZGLIADOV I.P. PAVLOVA NA PROTSESSY ISTOSHCHENIYA I VOSSTANOVLENIYA VYSSHEI NERVENNOI DEYATEL'NOSTI [Experimental basis for I. P. Pavlov's views on the processes of exhaustion and restoration of the higher nervous activity]. Fiziol. Zhur. SSSR, 2: 157-164. Abst.: Sovet. med. refer. Obozrenie, Fiziol., 1949 (4): 71.

The experimental study of the processes of neural exhaustion and restoration is based on exhaustion of the salivary glands after prolonged secretion. The percentage of dry residue or of other constituents of the saliva were used as an indicator of gland exhaustion. The following five general rules were observed during studies of glandular exhaustion and restoration: glandular tissue changes, occurring during activity inducing exhaustion, are the main stimulators of the restorative process; the rapidity with which exhaustion is incurred is a factor in restoration; the process of restoration is wave-like; a stable or unstable condition can be found in a gland where a normal level of restoration has been reached; the repetition of exhaustive functional activity may result either in a training of the gland in cases where it is permitted to return to normal before further hyperactivity, or in chronic exhaustion when the gland is repeatedly exhausted without interim return to stable restoration. A functional relationship or physiological similarity between the processes of exhaustion and recovery and the processes of stimulation and inhibition is discussed.

Fomin, D. A., 1941. K VOPROSU O SEKRETSII SLIUNNYKH ZHELEZ U TELIAT [On the secretion of the salivary glands in calves]. Fiziol. Zhur., 30 (4): 524-527. Unconditioned and conditioned salivation was studied in 6 calves, from 20 days to 1 year and 8 months of age, with permanent parotid and "mucous"-gland fistulae. Bicarbonate of soda was added to the animals' daily diet. The collection and measurement of the saliva was done in the usual manner. Findings are as follows.

The uninterrupted parotid secretion is absent in calves of the suckling age when their pregasters are not yet developed; it begins with the animal's transition to a coarse vegetal diet.

There is a regular reduction in the uninterrupted salivation of calves after sudden stimulation of various sensory receptors: sight, hearing, smell, skin. After frequent repetition of the same stimulant, the inhibiting effect gradually disappears.

Defecation and urination always lead to a reduction in parotid salivation.

Salivation is very sharply reduced during the animals' sleep.

Stimulation by hay, grass, bran, barley flour, beets, acetic acid and sodium sulfate increases the secretion; 0.5% hydrochloric acid, and other

substances, leave it almost unchanged; water, flour mash, milk, solutions of bicarbonate of soda, sand, etc. usually decrease the flow. The highest secretion was elicited by hay, grass and beets.

Rumination and feeding with coarse vegetal food always increases parotid salivation. Rumination on one side of the mouth increases parotid salivation ipsilaterally.

During a 24-hour experiment parotid secretion from one gland amounted to 12 l. of alkaline saliva, which corresponds to a loss of 100 gm. of alkali.

Subcutaneous injection of 0.4 to 0.5 mg./kg. pilocarpine sharply increases the uninterrupted salivation; in suckling calves it elicits a long secretion (over one hour).

The same dose of atropine considerably reduces the uninterrupted secretion, but is unable to block it completely.

Conditioned reflectory stimulation through teasing with food has a double effect on parotid function: during strong uninterrupted secretion it reduces salivation, during a low secretion it increases it.

The working out of a conditioned reflex to the sounding of a metronome includes three stages: first, a reduction of the uninterrupted secretion, then, absence of reaction, finally, increase of the secretion. (These facts completely contradict the findings of Prof. Krinitsyn and his coworkers, Khrutskii, Pavlov - 1938, Elovskii, et al.) Experiments with a 100-watt lightbulb, the sounding of a bell, the combing of hide, etc., showed a reduction in uninterrupted salivation in the absence of any food stimulant, which, after repetition, was followed by the extinction of the inhibition. Stimulation with a 40-watt blue light bulb, is too weak to produce any reaction.

The "mucous" (submaxillary and sublingual) glands in calves secrete only when stimulated. They do not greatly differ from those of dogs, except for a few peculiarities: i.e. the drinking of water produces a considerable secretion, and rumination hardly elicits any secretion from these glands. The viscosity of their salivas greatly fluctuates depending on the stimulant introduced into the mouth; the greatest viscosity is due to stimulation by milk, the smallest - to grass, hay and oil meal.

The artificial conditioned reflex in these glands is formed quickly and easily [sic].

Forbes, J. C., 1931. DENTAL CARIES FROM A BIOCHEMICAL STANDPOINT. Jour. dent. Res., 11 (4): 491-598.

Available chemical data is correlated in a discussion of the etiology of dental caries. The neutralizing power of saliva, its pH, Ca, and PO₄ ion concentrations and other interacting factors are considered.

Forbes, J. C., 1932. EFFECT OF MEALS, AND THE CHEWING OF PARAFFIN AND GUM, ON THE ACID-NEUTRALIZING ACTION OF SALIVA. Jour. dental Res., 12 (5): 749-758.

Experiments were made on the effect of meals and of paraffin and gum chewing on the neutralizing action of saliva, and on the relationship between the neutralizing action, phosphorus concentration and the CO₂ combining power of saliva.

All saliva samples with the exception of those collected during chewing, were obtained with a

minimum of muscular movement. The acid-neutralizing action was determined with quinhydrone electrodes; the phosphorus content colorimetrically by Fiske and Subbarow's method for blood phosphorus; the CO₂ combining power by means of a Van Slyke apparatus for blood analysis.

It was seen that: (1) Approximately one half hour after breakfast or a light lunch, the acid-neutralizing power of saliva falls markedly; a less marked decrease follows a regular meal of meat, vegetables, bread, dessert, and coffee. When taken alone, oranges cause no decrease in neutralizing action. (2) The salivary neutralizing power is markedly increased by chewing stimulation, but returns to normal after chewing is stopped, indicating that mastication is not the cause of the decrease below the normal value occurring after a light meal. (3) It seems that a reciprocal relationship exists between the neutralizing power and the phosphorus concentration in the saliva of the same individual; no relationship is apparent between the neutralizing and the CO₂ combining powers.

Forbes, J. C., and W. B. Gurley, 1932a. EFFECT OF DIET ON THE ACID-NEUTRALIZING POWER OF SALIVA. Jour. dental Res., 12 (4): 637-645.

Experiments were made on six individuals, all but one in their twenties, to study if, and how, the neutralizing power of saliva is affected by diet.

The effects of normal and of three special diets were studied. Diet 1 consisted of cream of wheat, oatmeal, puffed rice, white bread, white of egg, gelatine, butter, cream, and tea or coffee; Diet 2, of large amounts of fruit, vegetables and milk, with only moderate amounts of meat, and very little bread; and Diet 3, similar to Diet 2, but with a reduction of fruits and vegetables and a meat supplement with eggs considerably increased.

The acid-neutralizing power of saliva was determined with HCL; six tables of data (one for each individual) are given, showing the amounts of HCL used and the effect of diet on the neutralizing power of saliva.

The following conclusions were reached: "A high-cereal or a high-grain diet tends to decrease salivary acid-neutralizing power, while a high-meat, high-egg, and high-vegetable-and-fruit diet tends to increase it. No relation was found between the acid-neutralizing power and the phosphorus concentration of saliva. The elements in food may be more important than its potential alkalinity in determining salivary-neutralizing power."

Forbes, J. C., C. D. Cox, and J. D. Smith, 1950. EFFECT OF CERTAIN HENDECYNOIC ACIDS AND THEIR AMMONIUM SALTS ON ACID PRODUCTION IN SALIVA CONTAINING GLUCOSE. Jour. dental Res., 29 (5): 583-588.

A study was made of the effects of four isomeric unsaturated fatty acids (9-hendecyenoic, 10-hendecyenoic, 6-hendecyenoic, and 2-hendecyenoic acid) and their salts on the rate of acid production and on the solution of calcium from tricalcium phosphate in the paraffin-stimulated salivas (plus glucose) of three individuals. The method is described in full.

All the acids and their salts showed a considerable inhibitory action on the production of acid in saliva.

When tested for effect on fermentation of baker's yeast, only 9-hendecyenoic acid was markedly inhibitory. Slight inhibitory action, however, was also exhibited by its ammonium triethanolamine salts.

Forbes, J. C., and J. D. Smith, 1951. EFFECT OF VARIOUS SALTS ON THE PRODUCTION OF ACID BY SALIVA CONTAINING FERMENTABLE SUGARS. Jour. dental Res., 30 (4): 494-495.

"Inorganic and various organic salts of copper and nickel, such as those of fatty acids, and their complex salts with bases such as ammonia and the ethanolamines, have been found to exert a marked inhibitory action on the production of acid by saliva containing either glucose or sucrose. Concentrations of these metals as low as 0.5 mg. per 100 c.c. exert definite inhibition, while concentrations of 3 to 4 mg. completely prevent acid formation. Concentrations around 10 mg. per 100 c.c. seem to destroy all the acidogenic organisms in saliva. Inorganic salts of mercury (ic), gold (ous), and silver are also active, whereas the salts of platinum, palladium, chromium, zinc, cobalt, aluminum, magnesium, iron and manganese have little or no activity. Since nickel and copper have relatively low toxicities, a study of their possible use in dentifrices would seem justified." (Complete paper.)

Forbes, J. C., and J. D. Smith, 1952a. STUDIES ON THE EFFECT OF METALLIC SALTS ON ACID PRODUCTION IN SALIVA. I. Jour. dental Res., 31 (1): 129-131.

The effects of various metallic salts on the pH changes of paraffin-stimulated saliva mixed with either glucose or sucrose were studied. Copper (3-4 mg./100 ml. saliva) salts completely inhibited acid formation; nickel, gold, mercury, and silver salts retarded acid formation while cobalt, magnesium, aluminum, iron, manganese, and chromic salts were relatively ineffective.

Forkner, Claude E., and L. S. Zia, 1934. VIABLE LEISHMANIA DONOVANI IN NASAL AND ORAL SECRETIONS OF PATIENTS WITH KALA-AZAR AND THE BEARING OF THIS FINDING ON THE TRANSMISSION OF THE DISEASE. Jour. exper. Med., 50 (4): 491-499.

A study of the nasal secretions, tonsils, and saliva of patients having proven kala-azar showed the leishmania to be present in large numbers in the nasal secretions of 9 out of 15 patients. Smears of the saliva of one of these patients were found to contain a few leishmania. It is suggested that the mode of transmission of the disease may be by the upper respiratory and alimentary tracts.

Forkner, Claude E., and L. S. Zia, 1935. FURTHER STUDIES ON KALA-AZAR. LEISHMANIA IN NASAL AND ORAL SECRETIONS OF PATIENTS AND THE BEARING OF THIS FINDING ON THE TRANSMISSION OF THE DISEASE. Jour. exper. Med., 61 (2): 183-203.

The results of intraperitoneal inoculation of Chinese hamsters with the sputum or saliva or both from 13 kala-azar patients showed that transmission of the disease had occurred in 2 cases. Five of the animals inoculated died before they could be examined for the presence of leishmania. The intraperitoneal inoculation of the nasal discharge from 14 patients showed the parasite to be present and to cause infection in 13 of the hamsters. It is suggested that these experiments support a theory of direct or indirect contact infection in the transmission of kala-azar.

Fosdick, L. S., and H. L. Hansen, 1934. CHEMISTRY OF SALIVA IN RELATION TO DENTAL CARIES. Jour. Dental Res., 14 (2): 163.

"Sound enamel, free from dentin, was shaken at body temperature for definite periods, with saliva from caries-susceptible and caries-free patients. Fresh salivas, and some that had stagnated for definite periods, were used, and solubility of enamel therein at various stages of stagnation noted. Salivas of all individuals, whether caries-free or caries-susceptible, were found to be (at least) saturated with tri-calcium phosphate. Definite difference between saliva from caries-free and caries-susceptible patients was noted." (Authors' abstract)

Fosdick, Leonard S., and Harold L. Hansen, 1936. THEORETICAL CONSIDERATIONS OF CARBOHYDRATE DEGRADATION IN RELATION TO DENTAL CARIES. Jour. Amer. dental Assoc., 23 (3): 401-407.

Powdered human enamel was shaken with saliva containing glucose for definite periods of time at body temperature. The saliva was analyzed for calcium and phosphate before and after shaking. It was found that samples of saliva from both caries susceptible and caries immune patients dissolved large quantities of enamel. However, when saliva was preserved with sodium fluoride, enamel did not dissolve; in many cases, calcium and phosphate ions were precipitated from the saliva. The authors state that this indicates that saliva is normally saturated with calcium and phosphate ions, but that when fermentation occurs, the acids produced dissolve enamel. When fermentation was prevented by the presence of sodium fluoride, there was no solution of dental enamel.

It was also observed that when unpreserved saliva had been shaken with enamel for 18 hours, an odor characteristic of yeast was produced. When the mixture was cultured, large numbers of yeast organisms were found.

Preliminary data on the action of yeast and Bacillus acidophilus [Lactobacillus a.] on the saliva-glucose-enamel mixture are given. Full details are reported in the paper, Fosdick et al., 1937.

Fosdick, Leonard S., Harold L. Hansen, and Charlotte Epple, 1937. ENAMEL DECALCIFICATION BY MOUTH ORGANISMS AND DENTAL CARIES: A SUGGESTED TEST FOR CARIES SUSCEPTIBILITY. Jour. Amer. dental Assoc., 24 (8): 1275-1280.

The action of fresh saliva on human enamel in the presence of sugar was studied by obtaining 25 cc. of human saliva stimulated by chewing gum (which furnished the sugar). After the pH was taken, a portion of the collected saliva was analyzed for calcium and the rest was placed in an 8-inch tube with 0.1 g. of powdered human enamel. The saliva was sterilized or preserved with toluene. The sealed tube was then shaken at 37.5°C. for 18 hours. It was centrifuged and the clear solution analyzed for calcium. The difference between the original calcium and the calcium content after shaking was taken as a measure of the solvent action of fresh saliva on human enamel. The action of stagnant saliva was also studied in a similar manner. The numerical results are presented in Tables 1, 2, and 3. The data indicated that human saliva is saturated or supersaturated with calcium phosphate. However, any saliva if allowed to stagnate in the presence

of sugar will decalcify the teeth. There was a marked difference in the rate at which caries-free and caries-susceptible saliva acted on the enamel in the presence of sugar.

The effect of pure strain and mixed organisms on the decalcification of enamel in human saliva in the presence of carbohydrate was studied. Gum-stimulated saliva was collected and analyzed for calcium. Each test tube, containing 10 cc. of saliva and 0.1 g. of enamel, was inoculated with a known quantity of pure-strain organisms which had been isolated from the mouth. Tubes were shaken at 37.5°C. for 18 hours. After this time a bacterial count and chemical analysis for calcium were made. The results of 11 pure-strain and 3 mixed organisms are presented in Table 5. From the bacterial data, it was observed that saliva of all individuals contains a heat or anti-septic sensitive material which will cause the production of acid from sugar and hence will decalcify human enamel. It was also indicated that this substance is present in different concentrations in the saliva of immune and of susceptible people, and may be either bacteria or some enzyme type of matter. Of the organisms studied, pure-strain yeast and Bacillus aerogenes [Aerobacter a.] produced the greatest decalcification.

Fosdick, Leonard S., Harold L. Hansen, and George D. Wessinger, 1937a. THE REDUCTASE ACTIVITY OF VARIOUS MOUTH ORGANISMS. Jour. Amer. dental Assoc., 24 (9): 1445-1452.

The ability of certain mouth organisms to convert pyruvic acid to lactic acid was studied on human saliva. Six organisms were used: Saccharomyces cerevisiae (yeast), Sarcina lutea, Bacillus aerogenes [Aerobacter a.], Bacillus subtilis, Staphylococcus aureus, and Bacillus acidophilus [Lactobacillus a.]. The organisms were grown in sterile 1% dextrose broth for 72 hours, then centrifuged for 20 minutes at 4,700 r.p.m. and the supernatant liquid discarded. The residue was suspended in saline solution and the bacteria were collected on porous clay plates and dried. The dried bacteria were ground to a fine powder.

Paraffin-stimulated saliva was sterilized and made neutral or slightly acid. To 25 cc. of saliva were added 0.2 g. tricalcium phosphate and 50 mg. of the dried organisms. The tube was sealed and shaken for 4 hours at 37.5°C.; a second tube was shaken for 8 hours; and a third tube, used as a control, was prepared in the same manner except that no organisms were added. After the stated length of time the tubes were centrifuged for 15 minutes at 4,700 r.p.m. The supernatant liquid was withdrawn for analysis. From the tabulated data on the action of mouth organisms on pyruvic acid in saliva, it was observed that all the pyruvic acid which disappeared did not reappear as lactic acid. Certain explanations for this condition are presented.

Of the 6 organisms tried, the yeast and B. acidophilus consistently reduced more pyruvic to lactic acid than did the other organisms tested. B. subtilis was inconsistent in its action on pyruvic acid. B. aerogenes showed appreciable activity and S. lutea reduced very little pyruvic acid to lactic acid, and S. aureus absolutely none.

In some experiments pure cultures of yeast were obtained from the mouth and were allowed to

act in a mixture of saliva, glucose, and powdered enamel. The mixture was shaken for different periods of time at body temperature. The saliva was analyzed for calcium before and after shaking. The average amount of dental enamel dissolved in 20 trials was equivalent to 22 mg. of calcium per 100 cc. in 18 hours. The same procedure was tried with *B. acidophilus*, but produced no effect. When a mixture of yeast and *B. acidophilus* was tried, 8 tests gave an average decalcification equivalent of 45 mg. of calcium per 100 cc., indicating a symbiosis of the 2 organisms.

Fosdick, Leonard S., 1938. CARBOHYDRATE DEGRADATION BY MOUTH ORGANISMS. Jour. dental Res., 17 (4): 302.

Hexose phosphoric acid, phosphoglyceric acid, pyruvic acid, lactic acid, acetic acid, and butyric acid were isolated from saliva-tricalcium phosphate medium upon glucose fermentation. This fact suggested that the "path of fermentation by mouth organisms is similar to production of lactic acid by tissue enzymes and production of alcohol by yeast enzymes."

Fosdick, L. S., and E. E. Campaigne, 1939. SOME CHEMICAL DIFFERENCES BETWEEN THE SALIVA OF CARIES-IMMUNE AND THAT OF CARIES-SUSCEPTIBLE PATIENTS. Jour. Amer. dental Assoc., 26 (6): 954-957.

Experiments were conducted on the rates of total acid formation, combined lactic and pyruvic acid formation, and the carbon dioxide capacity. Paraffin-stimulated saliva was collected from caries-free and caries-susceptible patients. A portion of saliva was used to determine the carbon dioxide capacity; the rest was centrifuged, and the clear supernatant fluid was used to determine the amount of dissolved calcium and the amount of lactates and pyruvates. To an additional 15-cc. portion was added 0.7 g. of sucrose, 0.1 g. of glucose, and about 0.1 g. of powdered human enamel. The mixture was placed in an 8-inch tube, sealed, and shaken for 4 hours at 37.5° C. The difference in the amount of calcium in the fresh centrifuged saliva and the amount of calcium in the stagnant saliva were taken as the measure of the acid formed.

The Van Slyke manometric apparatus was used in determining the amount of pyruvic and lactic acids formed, utilizing the fact that pyruvic and lactic acids are oxidized by acid potassium permanganate to carbon dioxide, mole for mole.

The following are the average values, expressed in millimols per liter of saliva, for the 10 caries-free patients for the constituents studied: The difference in the amount of calcium in the fresh saliva and in the stagnant saliva was 1.4; the amount of lactic acid and pyruvic acid before shaking was 7.7; after shaking, 15.2. The average carbon dioxide capacity was 42.2 cc./100 cc. of saliva.

Data for 10 caries-susceptible patients are also given and compared with the data for the caries-free patients.

Fosdick, L. S., and E. Campaigne, 1939a. THE ACIDITY OF ISOLATED MOUTH AREAS. Jour. dental Res., 18 (3): 261.

"The acidity of isolated mouth areas and mouth plaques have been measured by means of a micro glass electrode. The pH was measured before and

at various intervals after ingestion of carbohydrate, for both susceptible and immune patients. It was found that for saliva a rise occurred after carbohydrate ingestion, but there was a drop in pH in the isolated areas after carbohydrate; then a gradual return to normal at the end of a 1/2-hour interval, in the susceptible patients. The isolated areas of the immune patients tended to follow more closely the normal saliva curve. The initial values for susceptibles was lower than those of the immune. Concentrations of hydrogen ion sufficient to decalcify human enamel have been demonstrated." (Complete paper.)

Fosdick, L. S., 1939(b). CARBOHYDRATE DEGRADATION BY MOUTH ORGANISMS. Jour. Amer. dental Assoc., 26 (3): 415-417.

The degradation products of a saliva-glucose-tribasic calcium phosphate medium, consisting of lactic, pyruvic, acetic, phosphoglyceric and possibly butyric and hexose-phosphoric acids, were isolated. These products correspond to those formed in tissue and in alcoholic fermentation. If oral carbohydrate degradation by microorganisms is similar, such acids as phosphoglyceric, pyruvic, acetic, butyric, and lactic may partake in caries formation.

Fosdick, L. S., and G. D. Wessinger, 1940. CARBOHYDRATE DEGRADATION BY MOUTH ORGANISMS. II. YEAST. Jour. Amer. dental Assoc., 27 (2): 203-212.

In a series of experiments the degradation of carbohydrates to lactic acid by mouth yeast (*Saccharomyces cerevisiae*) was studied. The yeast used in this investigation was isolated from human saliva or from the scrapings taken from the teeth. A new method for growing yeast on a large scale was devised. Organisms used in the study were not in an actively growing state, but the enzymes were nevertheless still present.

4 g. of dry, powdered mouth yeast was added to 30 ml. of 10% glucose solution. The mixture was incubated at 37° C. for various periods of time, with frequent shaking. At the end of the incubation period, the mixture was examined for phosphate and glucose contents. The results showed that in the phosphorylation of glucose, the rate of reaction is very fast, indicating that mouth yeast is very rich in phosphatase enzymes.

Mixtures containing yeast paste, phosphates, and glucose were incubated at 37° C. for 24 hours, with frequent shaking. Analysis of the mixture indicated that the production of phosphoglyceric acid by the mouth yeast was very slow. The same results were found in determining the degradation of phosphoglyceric acid by mouth yeast.

In studies on the reduction of pyruvic acid to lactic acid by mouth yeasts, dried mouth yeast was allowed to react with sodium hexose diphosphate and pyruvic acid in the presence of powdered tooth enamel. The mixture was shaken at 37° C. for 4 hours. It was found that of the 3.16 g./100 ml. of pyruvic acid originally present in the mixture, 2.75 g./100 ml. was decomposed, producing 1.18 g./100 ml. of lactic acid.

Human saliva was obtained by paraffin stimulation and was mixed with 2.0 g./100 ml. of pyruvic acid. To the saliva mixture was added 2.0 g. of dried mouth yeast and about 0.5 g. of powdered tooth enamel. Tubes were shaken in the

thermostat for 4 hours. After the incubation period, the mixture was analyzed for lactic and pyruvic acids. The transformation of pyruvic acid occurred very rapidly.

In experiments on the symbiotic effect of mouth yeast and *Lactobacillus acidophilus*, yeast alone was found to dissolve 22 mg. of Ca/100 ml. in 18 hours; *L. acidophilus* under the same conditions dissolved only 4 mg. of Ca. Whereas, a mixture of yeast and *L. acidophilus* gave an average decalcification equivalent to 45 mg./100 ml.

The experimental results of the full paper are discussed in relation to symbiosis of oral organisms.

Fosdick, L. S., E. E. Campaigne, and O. Fancher, 1941. RATE OF ACID FORMATION IN CARIOUS AREAS: THE ETIOLOGY OF DENTAL CARIES. Illinois Dental Jour., 10 (3): 85-95.

The formation and presence of acid in dental caries is studied as well as the acid neutralizing power of saliva. Hydrogen ion concentration determinations indicated that the acid content of most caries was not sufficient enough to produce decalcification reactions. However, a very rapid production of acid occurs in caries-susceptible individuals after the introduction of sugar (in the form of candy); sugar-generated acid was not formed, or was rapidly neutralized by the saliva of caries-immune persons. Lactic acid was found to be present in the caries accompanied by a similar amount of pyruvic acid. Lactic acid caries-content varied from 0.2% before the chewing of candy, to 0.3% afterwards.

A detailed description is given of a micro glass electrode for measuring the pH of small (to 0.001 cc.) oral samples, and a microtechnique for analyzing small caries samples is discussed.

Fosdick, L. S., and A. C. Starke, Jr., 1941a. CARBOHYDRATE DEGRADATION BY MOUTH ORGANISMS. III. *L. ACIDOPHILUS*. Jour. Amer. dent. Assoc., 28 (2): 234-240.

Tests of the degradation of glucose to lactic acid, similar to those using mouth yeast (Fosdick, 1940m), were made using *Lactobacillus acidophilus* isolated from human saliva and tooth scrapings. Tests of phosphorylation of glucose by *L. acidophilus* at various pH levels showed little or no such reaction occurring in 4 hours, 24 hours incubation being required to produce an amount equal to that produced by the yeast in 4 hours. Results of degradation of phosphoglyceric acid to pyruvic acid showed values, when multiplied by 1.4, comparable to those obtained with yeast. Tests of the reductase activity of the lactobacillus showed the organism to reduce pyruvic lactic acid in the absence of a hydrogen donor found in sterile saliva as was required in the tests with the yeast. The symbiotic relationship between yeast and *L. acidophilus* is discussed in relation to acid formation in mixtures of saliva, glucose, and powdered tooth enamel. It is suggested that other organisms in the presence of yeast and *L. acidophilus* may increase the rate of decalcification of tooth enamel.

Fosdick, L. S., O.E. Fancher, J. C. Calandra, 1942. THE EFFECT OF SYNTHETIC VITAMIN K ON THE RATE OF ACID FORMATION IN THE MOUTH. Science, 96 (2480): 45.

A study was made of the possibility of using synthetic vitamin K (2 methyl 1-4 naphthoquinone) to inhibit the chain reactions involved in the production of lactic acid in the mouth, long enough to allow the saliva to neutralize the acid and prevent caries. Results of in vitro tests showed an inhibition of acid production in a saliva-glucose mixture with synthetic vitamin K added; clinical tests showed the acidity of carious lesions to increase rapidly from pH 6.8 to pH 4.0 in the absence of vitamin K. It is suggested that synthetic vitamin K prevents the dismutation of the hexose phosphates or the conversion of the dismutation products to phosphoglyceric acid.

Fosdick, L. S., and G. W. Rapp, 1944. THE EFFECT OF PROTEOLYTIC ENZYMES ON ACID FORMATION IN THE MOUTH. Jour. dental Res., 23 (2): 81-83.

The effect of papain, trypsin, and pancreatin in various concentrations on the acid formation from fermentable sugars in human saliva was studied. The acid formed was determined by its solution effect on human tooth enamel according to the method previously described (cf. Fancher et al., 1944m).

The proteolytic enzymes did not cause an inhibition of the acid formation as was expected. Trypsin and papain caused a marked stimulation, while pancreatin showed no appreciable effect.

Fosdick, L. S., and G. W. Rapp, 1944a. THE EFFECT OF AMYLOLYTIC ENZYMES ON ACID PRODUCTION IN SALIVA. Jour. dental Res., 23 (2): 85-87.

The effect of amylolytic enzymes on acid production in saliva was studied in saliva which was collected following paraffin stimulation. The ptyalin activity of the saliva (47 individuals) was analyzed by Meyers' method; the amount of acid formation was measured by a method previously described (cf. Fancher et al., 1944m).

Marked increase in the acid formation was observed when various concentrations of the pancreatic amylase, amylopsin, were used. In a concentration of 400 mg. of amylopsin per 100 cc. of saliva, there was a 100% increase in the rate of acid formation. When the acid formation was plotted against the ptyalin index, a similar result was obtained. In general, the salivary samples that contained the largest amount of ptyalin showed the fastest acid formation.

Fosdick, L. S., and J. C. Calandra, 1947. THE EFFECT OF SOME CHEMICALS ON THE RATE OF ACID FORMATION IN SALIVA. Jour. dental Res., 26 (4): 309-317.

The effect of thirty-one compounds (peroxides, quinones, guanidines, aldehydes, etc.) on the rate of acid formation in saliva was studied. Paraffin-stimulated saliva was collected and divided into 10 cc. portions. The calcium content of one portion was determined; 1 g. glucose and 0.1 gm. of 300-mesh powdered human tooth enamel were added to the other samples. Various amounts of the test compounds were added. After 4 hours incubation at 37° C., the calcium content was again determined. The amount of acid formed was expressed in mg. Ca dissolved in 100 cc. saliva. Procedure is described in detail. With the exception of Luperco (a mixed organic peroxide), all the organic peroxides, quinones, and hydroquinones studied were inhibitory in comparatively

low concentrations. The guanidines were effective in very high concentrations only. Glycerol aldehyde, normally a product of metabolism as phosphoric ester, was inhibitory in the higher concentrations; the authors indicate this compound warrants further investigation. The low mol weight aldehydes, some of which are normal body constituents, were inhibitory.

Fosdick, L. S., and W. E. Ludwick, 1948. AMMONIA CONTENT OF DENTAL PLAQUE IN RELATION TO DENTAL CARIES. Jour. Dental Res., 27 (6): 735.

"It has been suggested that ammonium ion concentration in saliva is a major factor in determining susceptibility or immunity to dental caries. If ammonia is present in a concentration of fifty milliliters per one hundred cubic centimeter, the *Lactobacillus acidophilus* ceases to grow. If the concentrations are a lower order of magnitude, then saliva can be made to support the growth of *Lactobacillus acidophilus*. In so far as saliva from either immune or susceptible mouths does not ordinarily contain the amounts of ammonia that would be necessary to inhibit the growth of *Lactobacillus acidophilus*, it was suggested by Kesel that perhaps the ammonia would be concentrated in the dental plaques. For this reason an attempt was made to determine the amount of ammonia in material removed from the teeth. In so far as one of the methods of removing debris from the tooth surface is by brushing the teeth, it was thought that comparative data could be obtained by analyzing tooth brushings for ammonia. It was found that instead of using an ordinary dentifrice, the brushing could be accomplished quite readily with permutit, which would serve the double purpose of absorbing all of the ammonium ions while in contact with the tooth surface. For this reason, tooth brushings using permutit as the dentifrice were analyzed. This procedure was repeated on saliva of one thousand individuals. The tooth brushings were collected immediately upon arising and the following day the salivary specimens were gathered for acidophilus counts. In addition to this, each individual was given a complete mouth examination, including bite-wing x-rays and the caries activity was clinically estimated. The ammonia content of the brushings was correlated with the *L. acidophilus* count and with the clinical estimation of caries activity." (Authors' abstract)

Fosdick, L. S., and R. Q. Blackwell, 1949. THE DETERMINATION OF AMINO ACID CONTENT OF FRESH AND PUTREFIED SALIVA BY PAPER PARTITION CHROMATOGRAPHY. Jour. dental Res., 28 (6): 644.

"The amino acid content of caries-active, caries-immune, and periodontal disease saliva was determined on saliva samples, both fresh and following varying lengths of incubation. One-dimensional paper chromatography was used for the determinations. Six caries-active, four caries-immune, and three periodontal disease cases were studied. On the basis of the limited number of cases studied, it would appear that higher concentrations of aspartic and glutamic acids occur in caries-active saliva than in periodontal disease saliva with intermediate amounts present in caries-immune saliva. More work, which is being carried on in this laboratory at the present time, is necessary to establish the statistical significance of the apparent trend." (Complete paper.)

Fosdick, Leonard S., and Earl A. Zaus, 1953. EFFECTS OF SALIVA ON GASTRIC DIGESTION. Jour. Dental Res., 32 (3): 182-183.

"Basal flow of saliva averaged about 0.5 cc. per minute. Stimulated flow, induced by gum chewing averaged 2.5 cc. per minute ranging between 0.9 cc. and 7.0 cc. per minute. Acid-neutralizing power of basal saliva showed both individual and group variations; the average was equivalent to 0.017 N NaOH. Stimulated saliva usually ran higher than basal, and was equivalent to about 0.025 N NaOH. Test meals of 100 cc. of saliva produced little or no stimulating effect upon gastric secretion. Salivary mucin did not directly influence the action of pepsin. Saliva affects peptic activity indirectly, by changing the pH of gastric contents, swallowed saliva causing both dilution and neutralization. The degree of change depends upon rate of secretion of saliva that is swallowed and height of the gastric-secretion curve. The greatest effect upon free HCl in gastric juice occurs during the early period of digestion, when salivary flow is abundant owing to stimulation by mastication of food. This accounts in part for the slow rise in free HCl early in the digestive cycle, although the acid secreting glands are very active." (Authors' abstract)

Fosdick, L. S., J. C. Calandra, R. Q. Blackwell, and J. H. Burrill, 1953a. A NEW APPROACH TO THE PROBLEM OF DENTAL CARIES CONTROL. Jour. Dental Res., 32 (4): 486-496.

Screening tests were performed on 381 chemical compounds to evaluate their use in a dentifrice or mouthwash. The tested compounds are listed as inhibitors of acid formation in saliva-sugar at concentrations of 5, 10, 25, or 50 mg./100 ml. The screening tests showed 10 compounds to be effective. Three of these compounds found effective in further, in vivo tests are penicillin, sodium N-lauroyl sarcosinate, and sodium dehydroacetate.

Fosdick, L. S., R. Q. Blackwell, and W. J. Carter, 1953b. CHEMICAL STUDIES IN PERIODONTAL DISEASE. XI. THE VOLATILE AMINE CONTENT OF SALIVA. Jour. dent. Res., 32 (5): 646-647.

A study was made of the volatile amine content of saliva to determine whether it could be used as a rapid chemical test for periodontosis. The test was positive in 96 percent of the 25 cases of periodontosis studied; in 10 cases of periodontitis the test was negative in 80 percent of the cases; in 88 persons with normal gingivae the test was negative in 85 percent of the cases.

Fosdick, L. S., R. Meyer, Jr., and R. Q. Blackwell, 1958. THE PRODUCTION OF AMMONIA AND VOLATILE AMINES IN SALIVA. Jour. dent. Res., 37 (1): 31.

Saliva was collected by paraffin stimulation from subjects selected clinically as being periodontally normal, or as having suffered severe periodontal bone loss. A measured amount of saliva was incubated for 4 hours with added casein and was then centrifuged and divided into 2 portions each of which was made alkaline and distilled in a micro-Kjeldahl apparatus. The volatile alkaline substances were collected in boric acid and titrated with 0.02 N HCl. After the sample was titrated it was transferred to a

volumetric flask, nesslerized, and the amount of ammonia estimated by means of a Coleman spectrophotometer. The results were expressed as micro-equivalents per 100 ml. saliva. It was found that the saliva from patients suffering with periodontal disease usually formed a larger amount of volatile amines than the saliva from periodontally normal persons. (Author's abstract)

Foyt, E., and A. Hobaek, 1947. ACID PRODUCTION IN SALIVA/CANE SUGAR SOLUTIONS. *Nature*, 160 (4074): 758.

A study was made of acid production in saliva/cane sugar solutions from caries-susceptible subjects and from subjects with no active caries. Results of incubation of such samples at 37°C showed a rapid drop in the pH of the saliva/cane sugar mixture from persons with rampant caries. It is suggested that this rapid drop in pH is due to an enzyme system present in the saliva rather than to the activity of microorganisms.

After centrifuging or filtering saliva, the centrifugates were found to be inactive while the precipitates produced rapid acid formation when mixed with a cane sugar solution.

In a study of the rate of removal of soluble substances from oral retention areas, pellets of filter paper dyed with a water-soluble dye were pressed between proximal surfaces of teeth. After 2 hours without food or drink intake, more than 50 percent of the dye was washed out.

Francis, Thomas, Jr., 1940. THE INACTIVATION OF EPIDEMIC INFLUENZA VIRUS BY NASAL SECRETIONS OF HUMAN INDIVIDUALS. *Science* (New York), 91 (2356): 198-199, Feb. 23, 1940.

Over a period of 15 months the nasal secretions of human subjects were studied to ascertain whether the secretions possessed any capacity to inactivate epidemic influenza virus.

Nasal discharge was collected from 31 patients in the first day or two of an acute febrile common cold and from 2 hay-fever patients. The collections were ground individually with alundum and centrifuged. 0.3 cc. of the supernatant fluid was mixed with 0.3 cc. of a 1:2,000 suspension of mouse passage virus of the PR8 strain. After incubation at 37°C. for 30 min., 0.05 cc. of the mixture was given intranasally to 3 mice. The mice were observed for 10 days.

Secretions were also obtained from 15 normal individuals by inserting a loose pack of absorbent cotton well back into the nostrils until it became saturated. It was then removed and the clear liquid expressed. This material and salivary samples from the normal individuals were tested in the same manner as the common cold secretions.

The degree of virus inactivation was classified as complete when the mice survived without pulmonary lesions; almost complete, when they survived but exhibited mild lesions; partial, when extensive lesions were found; no inactivation, when the mice failed to survive. There was little difference between the results obtained with nasal secretions from patients with common colds and those from normal subjects. Approximately half caused complete or almost complete inactivation of 1,000 lethal doses of virus, while the other half exerted either slight or no inactivation. Saliva was ineffective.

The inactivating agent has been observed to have the following characteristics: It is extremely

stable at icebox temperature, remaining 6 to 8 weeks without change in potency. It is ineffective after heating at 70-75°C. for 20 min. The material can in some instances exert its action after dilution; the highest effective dilution observed was 1:8. Inactivation of virus by secretions is not the result of bacterial action, since many of the samples were sterile or yielded only a few colonies on blood agar plates. The agent is not a lysozyme as demonstrated by its action upon a susceptible micrococcus. The secretions have not been found to exert a bacteriostatic or bacteriolytic action when tested with smooth or rough pneumococcus [*Diplococcus pneumoniae*], β hemolytic streptococcus [*Streptococcus pyogenes*], *Streptococcus viridans* [*S. mitis*], *Staphylococcus aureus* [*Micrococcus pyogenes* var. *aureus*] or *albus* [*M. p.* var. *albus*], *M. catarrhalis* [*Neisseria c.*], or meningococcus [*N. meningitidis*].

It is concluded that a substance exists in nasal secretions (resembling in some respects the so-called natural antibodies) which is capable of inactivating relatively large amounts of influenza virus.

Francis, Thomas, Jr., and Elva Minuse, 1948. INFLUENCE OF SALIVA UPON HEMAGGLUTINATION BY INFLUENZA VIRUS. *Proc. Soc. exper. Biol. Med.*, 69 (2): 291-294.

The effects of saliva were studied upon the hemagglutinating action of the influenza virus.

Unstimulated saliva samples (20-25 cc.) were collected and centrifuged to remove solid particles and mucin. Clear supernatants were removed; when specimens contained a great deal of mucin, they were further treated with alundum and centrifuged again. If further treatment was necessary, the specimens were filtered through cotton and gauze. Small amounts of mucin remained in some samples.

In the first experiments, the effect of saliva on the hemagglutinating action of the influenza virus (strain PR8) was studied. Two-fold dilutions of the influenza virus Type A were made in 0.25 cc. volumes of physiological salt solution. 0.25 cc. of undiluted centrifuged saliva were added to each dilution and the mixture was allowed to stand at room temperature for 30-60 minutes. 0.5 cc. of 0.25% chicken erythrocyte suspension was added to the mixture. Control titrations of virus and saliva alone were similarly carried out. Saliva decreased the hemagglutinating titer of the PR8 strain of influenza virus from 8-512 times. The effectiveness varied in different individuals and, in the same individual, at different times. Some deterioration of the inhibiting substance upon standing was suggested.

Inhibition tests with various dilutions of saliva constituted the second experiment. 0.5 cc. of a 1/1,000 dilution of PR8 virus were added to two-fold dilutions of saliva, made directly in 0.5 cc. of 0.25% red cell suspension. (This maximum dilution of the virus represented two agglutinating units per tube). Although, at first glance, this method did not seem to be as effective as the first method, it nevertheless gave comparable results.

The effect of saliva on chicken erythrocytes was studied. 8 cc. of 0.25% erythrocytes, mixed with 3.5 cc. to 4.0 cc. of saliva, were allowed to stand at room temperature for 30-60 minutes,

and were occasionally shaken up. After centrifugation, the cells were resuspended in 8 cc. of fresh saline without washing, and were then added to a series of virus dilutions. 0.5 cc. saline solution and 0.5 cc. of cells constituted a control. When spontaneous agglutination of erythrocytes was caused by saliva, these cells continued to agglutinate even when removed from the mixture and when resuspended in fresh saline; very little effect on the virus titers was noticed in most cases when cells were treated with saliva. The inhibiting influence, therefore, appears to be upon the virus rather than upon the erythrocytes.

All combinations of heated or unheated virus and saliva samples were tested. Spontaneous agglutination of erythrocytes by certain samples was eliminated by heating the saliva. Otherwise, no significant effects of heating were observed.

Frazier, A. C., Wm. Neidermeier, G. Okunzua, and H. G. Sammons, 1956. [Table] 50. SALIVA, PHYSICAL AND CHEMICAL CHARACTERISTICS: VERTEBRATES. In: HANDBOOK OF BIOLOGICAL DATA, W. S. Spector, ed. Philadelphia, W. B. Saunders, 1956, p. 60.

Values from the literature are given for 74 physical properties or chemical constituents of human saliva. Five such salivary values are also given for cattle, 7 for the dog, 6 for the goat, 5 for the horse, 11 for sheep, 5 for swine, and of the pH in the chicken.

Freeman, E. B., 1931. A STUDY OF HYDROGEN ION CONCENTRATION AND DIASTASE CONTENT OF MOUTH SECRETION, IN RELATION TO VARIOUS GASTROINTESTINAL DISTURBANCES. Trans. Amer. Gastro-Enterol. Assoc., 1931: 151-156.

An investigation was made of the hydrogen ion concentration and diastase content of the oral secretions of 214 patients grouped according to age, diagnosis, teeth and gum conditions, gastric acidity, pH of mouth secretion, diastase content, and suffering from splachnoptosis, gastric carcinoma, chronic cholecystitis, chronic appendicitis, gastric neurosis, non-specific ulcerative colitis, upper right quadrant adhesions, jaundice (catarrhal and obstructive), or achylia gastrica.

Tabulated results revealed that none of the above organic or functional diseases, nor does age or changes in the gastric acidity affect the hydrogen ion concentration or diastase content of oral secretions; that the pH was usually acid. Toothless individuals, however, generally produced a more alkaline oral secretion than did the other subjects investigated.

Freeman, Joseph T., and R. Hafkesbring, 1951. COMPARATIVE STUDY OF ASCORBIC ACID LEVELS IN GASTRIC SECRETION, BLOOD, URINE, AND SALIVA. Gastroenterol., 18 (2): 224-229.

Determinations of the average normal levels of ascorbic acid in gastric juice were correlated with similar determinations of saliva, urine, and whole blood, as well as with the total and free gastric acidity. Foods high in Vitamin C were withheld from the 110 normal individuals studied, 24 hours prior to the experiment. The method of Roe and Keuther and a modified method of Stuteville were used for the determination of ascorbic acid in the blood and urine, and saliva respectively.

The ascorbic acid content ranged from 0 to 0.372 mg.% (average, 0.07 mg.%) in saliva, 0.3 to

2.1 mg.% (0.98 mg.%) in whole blood, and 0 to 9.0 mg.% (1.59 mg.%) in urine; the average gastric ascorbic acid content was 0.95 mg.% before, during, and after test meal stimulation. The range and average of salivary ascorbic acid was independent of and showed no correlation with those of the urine, blood, and gastric contents.

Freeman, N. E., R. A. Phillips, and W. B. Cannon, 1931. AN UNSUCCESSFUL ATTEMPT TO DEMONSTRATE HUMORAL ACTION OF "VAGUS SUBSTANCE" IN THE CIRCULATING BLOOD. Amer. Jour. Physiol., 98 (3): 435-440.

An attempt was made to demonstrate the presence of a vagus or a parasympathico-mimetic substance in the circulating blood of 43 cats. The test organs used included the submaxillary gland, iris, heart, tongue, stomach, and intestines. Some of the organs employed had been sensitized by previous denervation; physostigmine was also given to try to enhance the action of the vagus substance. The results of all tests failed to show the presence of this substance in the blood during vagal stimulation.

Friedemann, Theodore E., 1934. THE EXCRETION OF ETHYL ALCOHOL IN SALIVA AND A RAPID METHOD FOR ITS DETERMINATION. Jour. biol. Chem., 105 (2): xxviii-xxix.

The following procedure is suggested for the determination of alcohol in saliva:

"About 80 cc. of water, 5 cc. of $\text{CuSO}_4 \cdot \text{HgCl}_2$ reagent (5 per cent $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$, 6.5 per cent HgCl_2), and 5 cc. of a 20 per cent $\text{Ca}(\text{OH})_2$ suspension are added to 1.0 cc. of saliva. The contents are mixed and the volume is brought to 100 cc. They are again mixed and allowed to stand about 10 minutes. They are then filtered through a 12.5 cm. filter paper, the first 15 to 25 cc. portion of filtrate being discarded. An aliquot of the filtrate is oxidized by alkaline KMnO_4 . Filtrates from normal saliva contain oxidizable material equivalent to about 12 mg. per cent of alcohol."

Friedemann, Theodore E., and Theodore Brook, 1936. THE DIRECT DETERMINATION OF ETHYL ALCOHOL IN SALIVA WITHOUT DISTILLATION. Jour. biol. Chem., 114 (1): xxxvii-xxxviii.

"1 cc. of saliva and 10 cc. of a solution consisting of 4 per cent $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$, 4 per cent HgSO_4 , and 1.5 per cent $\text{Fe}_2(\text{SO}_4)_3$ are measured into a 100 cc. volumetric flask. 50 cc. of H_2O and an excess of a suspension of $\text{Ca}(\text{OH})_2$ are then added. After mixing, the volume is brought to the mark. 10 cc. of the supernatant solution are measured into a flask. To this are added 15 cc. of H_2O , 10 cc. of 5 N NaOH, and 25 cc. of 0.01 N KMnO_4 . The contents are thoroughly mixed and then heated in a boiling water bath. After cooling, the contents of the flask are acidified, and the residual KMnO_4 is determined iodometrically. The quantity of alcohol oxidized is measured by the difference between the titration of the sample and the titration of a blank. 1 cc. of 0.01 N KMnO_4 is equivalent to 0.0420 mg. of ethyl alcohol. The results obtained by direct oxidation, when compared with those obtained by distillation, differ by a constant value, 12 ± 5 mg. per 100 cc." (Complete paper.)

Friedemann, Theodore E., 1938. THE DIRECT DETERMINATION OF ETHYL ALCOHOL IN SALIVA WITHOUT

DISTILLATION. Proc. Soc. exper. Biol. Med., 37 (4): 686-689.

"All but a small, but relatively constant, quantity of the oxidizable material of normal saliva may be removed by the addition of two reagents: (1) a solution of CuSO_4 , HgSO_4 , and ferric sulfate, and (2) a suspension of Ca(OH)_2 . The residual material from normal saliva is equivalent to 10.5 ± 4.5 mg.% of ethyl alcohol.

"A procedure for the direct determination, without distillation, of ethyl alcohol in saliva is described. The results are 11.2 ± 3.3 mg.% higher than by the method of Friedemann and Klaas." (Author's summary.)

Friedemann, Theodore E., W. G. Motel, and H. Necheles, 1938a. THE EXCRETION OF INGESTED ETHYL ALCOHOL IN SALIVA. Jour. Lab. clin. Med., 23 (10): 1007-1014.

A study was made of the alcohol content of the venous and arterial blood, urine, and saliva of 4 dogs and 9 human subjects. The differences between the alcohol concentration of mixed saliva and blood was found to be relatively slight while the results of urine analysis did not approximate those from blood. The presence of alcohol in human mixed saliva is attributed chiefly to simple diffusion.

A method for the collection of mixed saliva is described.

Friedenreich, V., and G. Thyssen, 1937. SUR LA PRÉSENCE D'ANTIGÈNES DE GROUPE A ET B DANS LA SALIVE DU CHEVAL [On the presence of antigens of groups A and B in horse saliva]. Compt. rend. Soc. Biol. (Paris), 126: 801-804.

Agglutination tests of pilocarpine-stimulated salivas of 52 horses showed the presence of 4 antigenic groups, A, B, AB, and O. As no antigenic difference was noted in the saliva of one of these horses before or after pilocarpine stimulation, pilocarpine is considered to have no effect on the presence of the antigen in the saliva. The A and B antigens in horse saliva appear to be closely allied to or identical with human A and B antigens. No corresponding groups were found in horse blood.

Fröhlich A. and O. Lowei, 1910. ÜBER EINE STEIGERUNG DER ADRENALINE-EMPFINDLICHKEIT DURCH COCAIN [On the increase of adrenaline sensitivity through cocaine]. Naunyn-Schmiedeberg's Arch. exper. Pathol. und Pharmakol., 62 (2-3): 159-169.

Combined subcutaneous injection of adrenaline and cocaine in the cat improved the duration and intensity of adrenaline action. This was ascertained in the blood vessels, in the eye, in the bladder, and in the salivary gland. In the salivary gland of the decerebrate cat, cocaine injection enhanced the hypertensive action of adrenaline. This salivary increase was not always immediately experienced but in each case the sensitizing effect of cocaine (but not a summation of the effect of both chemicals) was evident.

Fröhlich, A., and E. P. Pick, 1912. DIE FOLGEN DER VERGIFTUNG DURCH ADRENALIN, HISTAMINE, PITUITRIN, PEPTON, SOWIE DER ANAPHYLAKTISCHEN VERGIFTUNG IN BEZUG AUF DAS VEGETATIVE NERVENSYSTEM. [The effects of poisoning by adrenaline, histamine, pituitrin and peptone as well of those

of anaphylactic poisoning in relation to the autonomic nervous system]. Naunyn-Schmiedeberg's Arch. exper. Pathol. und Pharmakol., 71 (1): 23-61.

The intravenous injection of certain non-acidic substances (histamine, adrenaline, and peptone) as well as the impact of anaphylactic shock induce complete inhibition of the autonomic nerve endings. Administration of 1/2 mg. histamine into the prepared submaxillary gland followed by strong stimulation of the chorda nerve, and injection of pilocarpine into the gland induced no submaxillary salivation.

Frolov, A. A., 1948. VLIYANIYE BOLEVYKH RAZDRAZHENII BRUSHINY NA RABOTU SLIUNNYKH ZHELEZ [The influence of pain stimulation from the peritoneum on the action of the salivary glands]. Sbornik Trudov Ivanov. Sel'skokhoz Inst. Kafedra normal'. i patol. Fiziol., 10 (2): 118-128. Abst.: Sovet. med. ref. Obozrenie, Fiziol., 1952 (9): 93-94.

Peritoneal interoceptive influences on the salivary glands were investigated in dogs having fistulae of the parotid and mixed glands. Special electrodes, attached operatively to all animals, permitted stimulation of different portions of the parietal or visceral peritoneum; two dogs also had stomachs cannulated in the pyloric portion to permit faradic, chemical, or mechanical stimulation of the gastric mucosa. The interoceptive influences were studied at times of rest and during reflex or pilocarpine salivation.

The author concluded that experimental spasm of different portions of the stomach or of the intestine induces activity in the inactive gland (spontaneous salivation) and changes the intensity of pilocarpine salivation depending on the dose of pilocarpine. More pronounced changes in salivary activity are induced by spasmodic contractions of the gastric or intestinal walls, effected by faradic stimulation of the serous membrane; changes resulting from faradic stimulation of the peristaltic peritoneum are insignificant. The spasmodic contraction of the gastric or intestinal wall or faradic stimulation of the parietal peritoneum primarily influence the submaxillary glands. Experimental spasm of different portions of the stomach or intestine inhibits the unconditioned reflex salivation in response to oral food stimulation.

Frolov, S. A., 1948a. VISTERO-VISTSERAL'NYI REFLEKS S BRUSHINY [The viscerovisceral reflex from the peritoneum]. Biull. eksper. Biol. i Med., 1: 9-12. Abst.: Sovet. med. refer. Obozrenie, Fiziol., 1949 (3): 82.

Salivary activity was used to indicate the functional state of cerebral centers during strong faradic stimulations of the parietal and visceral peritoneum. The faradic stimulus was applied during periods of salivary inactivity and during periods of salivation induced by 0.5 to 1.0 cc. injections of pilocarpine. Peritoneal stimulation was found to induce salivation primarily from the submaxillary glands; salivation evoked by weak doses of pilocarpine was increased, while salivation elicited by strong doses was depressed. Stimulation of the visceral peritoneum produced the greater changes in salivary activity.

Frolov, A. A., 1952. OB AFFERENTNYKH VLIĀNIĀKH NA FUNKTSIĪ SLIŪNNYKH ZHELEZ [On afferent influences on the function of the salivary glands]. Fiziol. Zhur. SSSR, 1952 (5): 619-627. Abst.: Sovet. med. refer. Obozrenie, Fiziol., 1954 (17): 86.

One to 4 ml. of a 5% silver nitrate solution or 30 to 200 ml. of a hypertonic NaCl solution was injected into the peritoneal cavity of each of 13 dogs to study afferent peritoneal influences on salivation. Salivation was elicited by administration of food or of pilocarpine, and determinations were made of latency period, rate and duration of flow, and the chemical components of the saliva. Peritonitis, produced by either solution, produced an initial salivary inhibition followed by hypersecretion; changes were noted in the chemical composition. The salivary changes were stable, lasting one to two months and persisting after clinical recovery. Extirpation of the cervical sympathetic ganglion did not affect the interoceptive influence on salivary secretion; section of the chorda tympani or complete denervation of the salivary gland produced no change in the pilocarpine saliva. A more rapid restoration of salivary function, during induced peritonitis, after administration of bromide suggests salivary restoration to be connected to functional changes in the cortex.

Frouin, Albert, 1907. ACTION DE LA SALIVE SUR LA SÉCRETION ET LA DIGESTION GASTRIQUES [Action of saliva on gastric secretion and digestion]. Compt. rend. de la Soc. de Biol. (Paris), 62 (2): 80-81.

Experiments on the dog showed increase in quantity, acidity, and digestive power of gastric juice after either dog or cow saliva had been introduced into the stomach. Digestion was more complete and evacuation more rapid.

Furstenberg, A. C. and E. Crosby, 1945. DISTURBANCE OF THE FUNCTION OF THE SALIVARY GLANDS. Ann. Otol., Rhinol., and Laryngol., 54 (2): 243-264.

A review of literature discusses the dysfunction of the salivary mechanism and the changes in salivary flow which result from impairment of the nerve supply to the salivary glands.

Gad Andresen, K. L., 1921. DIE VERTEILUNG DES HARNSTOFFES IM ORGANISMUS [The distribution of urea in the organism]. Biochem. Zeitschr., 116 (1-6): 266-302.

Determination was made of the ammonia content in human saliva samples collected after ingestion of food. Results indicated that there was a balance between the urea content of the blood and that of the saliva. The ammonia concentration, however, was more considerable in the saliva than in the blood. In the next experiment, the oral cavity was cleaned before saliva samples were collected. This time the ammonia concentration was lower in the saliva than in the blood.

Gagna, I. M., 1949. VLIĀNIE MATERIALOV, PRIMENĀEMYKH V ZUBOPROTEZIROVANII NA NEKOTORYE SOSTAVNYE CHASTI SLIŪNY [The influence of materials used in dental prosthesis on some salivary constituents]. Trudy Tbilisskogo Stomatol.

Inst., 1: 94-95. Abst.: Sovet. med. refer. Obozrenie, Stomatol., 1951 (3): 31.

The influence of dental prosthetic materials on some constituents of saliva was tested in 32 dental patients. Salivary samples were collected before setting of the prosthesis, as well as 43 hours after and 7 to 30 days after the setting. The dry residue, both the organic and inorganic matter, and the diastatic power of the saliva increased under the influence of the prosthesis. The author prefers stainless steel to other dental prosthetic materials, as this metal activates the ptyalin of saliva.

Galippe, V., 1896. NOTE SUR LA RECHERCHE DE L'ACIDE URIQUE DANS LE TARTRE SALIVAIRE AN COURS DE LA PYORRHEE ALVÉOLAIRE (GINGIVITE ARTHRODENTAIRE INFECTIEUSE) [Note on research concerning uric acid in salivary tartar in the course of pyorrhea alveolaris. (infectious archro-dental ginginitis)]. Compt. rend. de la Soc. de Biol. (Paris), 48 (14): 418-420.

Attempts to find uric acid in dental tartar consistently gave negative results.

Galippe, V., 1896a. NOUVELLES RECHERCHES SUR LA NON-EXISTENCE DE L'ACIDE URIQUE DANS L'EXTREMITÉ DES RACINES DE DENTS ENVAHIES PAR LE TARTRE [New research on the non-existence of uric acid in salivary tartar and in root-ends of teeth attacked by tartar]. Compt. rend. de la Soc. de Biol. (Paris), 48 (28): 881-883.

Chemical analysis of dental tartar consistently gave negative results for the presence of uric acid.

Galippe, V., 1903. A PROPOS DES INFECTIONS D'ORIGINE BUCCALE. [Concerning infections of buccal origin]. Compt. rend. de la Soc. de Biol. (Paris), 55 (23): 859-861.

Constant swallowing of virulent and toxic saliva containing a large number of harmful parasites may cause infections of the digestive and respiratory organs, liver, kidney, and occasionally a generalized toxic condition leading to fatal endocarditis. The kidneys are frequently attacked; local treatment to clear up pyorrhea alveolaris almost always has resulted in improvement or complete disappearance of albuminuria. Pyorrhea alveolaris is considered an inexhaustible source of secondary infection, "such as diabetes."

Galperin, S. I., 1936. INTEROCEPTIVE IMPULSES OF THE SALIVARY GLANDS. Bull. Biol. Med. exper. URSS, 1 (6): 421-422.

Study was made of the reflex action elicited through stimulation of afferent nervous fibers proceeding from the salivary glands. The procedure adopted was the blocking of afferent fibers by novocain; 28 experiments were performed on 7 dogs and 21 cats. A cotton-wool wick moistened with a 0.2% novocain solution was placed under the chorda tympani. This caused, in most cases, a marked decrease of pilocarpine salivation on the side of the operation which occasionally reached 50%. An increase in salivary secretion was noted in some experiments. The difference in salivary secretion between the side treated by novocain and the control side disappeared after cutting the lingual nerve on the experimental side. Subsequent faradic stimulation of the

peripheral stump of the lingual nerve, or of the chorda above the place where the wick was applied, caused a sharp increase of pilocarpine salivary secretion which proved the integrity of the efferent impulses of the chorda. In a considerable number of preliminary experiments, the faradic stimulation of the chorda, after treatment with higher concentrations of novocain, still caused a sharp increase in salivary secretion.

The author concludes that the nerve centers receive from the functioning glands afferent interoceptive impulses which affect the central regulation of the activity of the glands.

Galperin, S. I. and G. N. Pribytkova, 1936a. VLIĀNIE VOZBUZHDENIĀ INTRATSEPTOROV NA RABOTU SLIŪNNYKH ZHELEZ I VYSSHĪŪ NERVNUIŪ DEĀTEL'NOST' [The influence of interoceptive stimulation on salivary gland activity]. *Fiziol. Zhur. SSSR*, 21: 783-784.

A literature review concerning the effect in the dog of interoceptive stimuli on the cerebral cortex and its control of salivation, introduces a study of the changes in prolonged salivation (after subcutaneous injection of 1.25 to 2.5 mg. of pilocarpine) produced by certain solutions introduced into the oral cavity, the stomach, or the fistulated duodenum. In tests where formation of a conditioned reflex was avoided, a weak HCl or sugar solution notably decreased the secretion rate of pilocarpine saliva. Administration of water or of bouillon sharply increased salivation 2 to 3-fold when introduced into the stomach 6 to 30 minutes after pilocarpine injection. A study of interoceptive influence on conditioned response showed this to be sharply decreased by water or bouillon if introduced directly into the stomach without notice to the animal but increased such response if introduced into the duodenum. Pilocarpine salivation was notably decreased during and 2 to 4 minutes after positive conditioned stimulation, while inhibitory conditioned stimulation increased pilocarpine salivation over the same period. The reflex arc involved in such salivary gland responses is discussed.

Galperin, S. I., 1936. INTEROTSEPTIVNYE IMPUL'SY SLIŪNNYKH ZHELEZ [Interoceptive impulses of the salivary glands]. *Ark. biol. Nauk, Leningrad*, 42 (1-2): 195-203.

Russian version of Galperin, 1936m, abstracted by author with the following conclusion added:

The experimental data collected suggests that novocain exerts its specific action on the afferent nervous fibers without touching the efferent fibers of the chorda. Therefore the alteration of the afferent chordal fibers, while changing the flow of afferent impulses from the salivary glands, also regulates the pilocarpine secretion from the nerve centers (along the efferent fibers), either decreasing or increasing the secretion. This is confirmed by control experiments in which, after resection of the lingual nerve, a novocain-moisture wick beneath the chorda produced no change in salivation rate on the operated side.

The central regulation of salivary secretion is shown by the experiments in which the novocain did not alter the salivary secretion rate on the experimental side after resection of the lingual nerve, despite the preservation of the efferent fibers, and by experiments in which the resection

of the lingual nerve on one side decreased the salivary secretion bilaterally.

Galperin, S. I., 1938. PROBLEMA CHUVSTVITEL'NOSTI VNUTRENNYKH ORGANOV [The sensitivity of inner organs]. *Ark. biol. Nauk, Leningrad*, 50 (1-2): 66-91.

The influence of interoceptive impulses from the oral cavity, stomach, and duodenum on actively-secreting salivary glands was studied in 6 dogs over a period of several years. Canine salivation was stimulated in all dogs by subcutaneous injection of 1.25 or 2.5 mg. of pilocarpine and 2-minute samples of saliva collected. Either a 0.25% HCl or a sugar solution was given orally during pilocarpine salivation in 3 dogs having a parotid fistula; 200 cc. of water or bouillon were introduced into the stomach or duodenum before or after the pilocarpine injection in the other dogs, each having fistulas of either the submaxillary glands and fundus, parotids and fundus, or parotids and duodenum. Test results showed that oral acid or sugar stimulation produced a short initial increase in salivary flow, followed by a pronounced and longer decrease, in dogs showing conditioned response to test procedures; an immediate sharp decrease in salivation followed similar tests omitting the oral stimulation. The acid and sugar solutions also produced distinct salivary changes involving colloid precipitation. In tests involving complete exclusion of exteroceptive stimulation, introduction of water or bouillon into the stomach 30 minutes before the pilocarpine injection distinctly diminished the pilocarpine salivation; salivation doubled if the fluids were given 15 minutes before or 3 minutes after the injection and tripled if given 6 minutes after the injection. Duodenal administration of the fluids, 30 minutes before or 6 minutes after the pilocarpine injection, produced exactly opposite results to those obtained with stomachal administration. The time factor involved in the reflex actions is discussed. In further tests with 3 dogs having firmly established positive and negative conditioned reflexes, the stomach was irrigated with water at body temperature 20 to 30 minutes before conditioned stimulation and 200 cc. of water or bouillon administered, unnoticed by the dog, 5 to 3 minutes before the conditioned stimulation; stomachal administration of either fluid decreased the ensuing conditioned salivation, duodenal administration increased it. Cortical influences on salivation were studied in 5 dogs having a parotid fistula as well as established conditioned reflexes and differentiation. Salivation elicited by injection of 2.5 mg. of pilocarpine, was markedly decreased 2 to 4 minutes after positive conditioned stimulation and markedly increased over the same period by negative conditioned stimulation; these sharp fluctuations were absent in control tests and were reversed in a dog having an excised superior cervical ganglion. Decerebrate cats and dogs, having a unilaterally exposed chorda tympani and cannulated submaxillary ducts, usually salivated 2 to 4 minutes after intravenous injection of 2.0-2.5 mg. of pilocarpine. The equal bilateral salivation obtained when the exposed chorda was treated with physiological solution, usually showed a drop up to 50% of flow on the operated side when the chorda was treated with 2% novocain; the inequality

of secretion disappeared after section of the lingual nerve. Subsequent faradic stimulation of the peripheral end of the lingual nerve, or of the chorda above the nerve block, sharply increased the pilocarpine salivation; higher concentrations of novocain did not change the chordal-stimulated pilocarpine salivation. The results suggest that alteration of the afferent chordal fibers while affecting the passage of afferent impulses from the salivary glands, induces a regulation from the salivary centers of pilocarpine salivation to increase or decrease salivary flow.

Gans, L. R., 1926. EXPERIMENTAL STUDY IN SALIVARY REACTION. Jour. Amer. Dental Assoc., 13 (2): 222-225.

Chemical examination of approximately 90 saliva samples (fresh, filtered, or filter-boiled), collected at random over a six-month period, indicated the following: The normal salivary pH ranges from 6.4 to 7.0, is independent of oral conditions, and shows no constant relationship to mouth abnormalities.

Gantt, W. Horsley, 1929. SALIVARY SECRETION AND THE INTAKE OF FLUID. Amer. Jour. Dis. Child., 37 (6): 1125-1127.

Thirst caused a marked diminution in salivary secretion, elicited by all foods, from that occurring after normal intake (1000 cc. fluid during breakfast three hours prior to the test). Forced intake (2000 to 3000 cc. fluid) produced only a slight increase in salivary secretion. An epileptic fit was found to result in a marked decrease in the unconditioned salivary secretion immediately following a convulsion.

Gantt, W. Horsley, 1937. THE NERVOUS SECRETION OF SALIVA: QUANTITATIVE STUDIES IN THE NATURAL UNCONDITIONED REFLEX SECRETION OF PAROTID SALIVA. Amer. Jour. Physiol., 119 (3): 493-507.

A study was made of the relationships between secretion of parotid saliva, amount of food, and body weight of the dog. Results of more than 8000 recorded measurements on 12 dogs, continued in some of the animals over a period of 5 years, show a direct relationship between the amount of secretion of parotid saliva and the amount of food which can be expressed as a straight-line function.

Most of the secretion (72-78%) occurred during the period of actual eating. Rate of eating had only a slight effect on the amount of saliva secreted for a given amount and kind of food.

Gardner, M. K., M. L. Snyder, and D. R. Porter, 1958. ACID FORMATION IN SUCROSE BY SALIVARY ACTION AS A MEANS OF PREDICTING NEW CARIES EXPERIENCE. Jour. dent. Res., 37 (1): 179-180.

Acid formation in sucrose broth by salivary activity as a means of estimating or predicting caries experience in the manner described by Rickles was tested in our project designed to evaluate laboratory tests for this purpose. Specimens of stimulated saliva were collected monthly from the study group during the school year and submitted for lactobacillus count, Snyder Test, and salivary amylase, as well as acid formation in sucrose. Clinical examinations conducted with mouth mirror and explorer with supporting bite-wing radiographs were made at 6-month intervals. Our evaluation for predictability was

limited, however, to a single set of saliva samples from 134 children and the data compared with the increment of new carious surfaces recorded 10 to 11 months later. Correlation studies indicated that acid formation in sucrose by salivary action could not be used to predict new caries experience in these children. (Author's abstract)

Garibian (Garibjan), R. B., 1936. UEBER MOTORISCHE NAHRUNGS- UND VERTEIDIGUNGSREAKTIONEN BEIM HUND. MITTEILUNG 2. SEKRETORISCHE UND MOTORISCHE AEUSSERUNGEN BEI NAHRUNGS- UND VERTEIDIGUNGSREAKTIONEN [On motor, food, and defense reactions in the dog. Communication 2. Secretory and motor manifestations in food and defense reactions]. Bull. Biol. Med. exper. URSS, 2 (3): 173-174.

The salivary rate and the relationship of parotid and submaxillary secretion (coefficient P/S) was studied in dogs. Use of the P/S coefficient permits registration of various processes which occur in the subcortical portion of the central nervous system.

A comparison of the motor and secretory components of food of defense reflexes usually reveals a parallelism in both components. In some instances however, which are detailed, this parallelism is disrupted, for example during the after-effect of the vanishing inhibition in food reflexes, and in two other cases.

Garibian, R. B., 1938. O PISHCHEVYKH I OBORONITEL'NYKH SEKRETORNYKH DVIGATEL'NYKH BEZUSLOVNYKH REAKTSII U SOBAKI. SOOBSHCHENIE 4. [On food and defense secretory and motor reaction in the dog. Communication 4]. Fiziol. Zhur. SSSR, 24 (4): 715-725.

Several series of experiments were made in the parotid and submaxillary glands of [two] dogs to establish the correlation of reactions induced by different stimuli from the same sensory receptors and originated in the same reflex center: 1) between the defense reaction to the pouring into the mouth of a 0.3% hydrochloric acid, and the food reaction to milk; 2) between the reactions to two foods, milk and a 10% sugar solution. The intervals between the different stimulations were kept at 35 min.

The tabulated results manifest an evident reciprocal influence between the secretory food and defensive reactions. Preliminary introduction of the acid always increases the salivary secretion elicited in response to milk. Preliminary introduction of milk, on the contrary, always depresses the salivary secretion elicited in response to hydrochloric acid. This reciprocal action is especially evident in alternate acid-milk and milk-acid stimulation. The stimulating or depressing influence of the preceding stimulus on the secretion elicited by the next is reflected in a similar manner in the secretions of all three glands; thus, the coefficient P/S (parotid/submaxillary) undergoes but slight fluctuations.

There are indications that the reciprocal influences of these stimuli on salivary secretion extend over a longer period of time than the one applied in these experiments (35 min.). If the same stimulus was applied during several days, the secretion obtained on the following day in response to the second stimulus was altered according to the nature of the first: depressed,

if the first stimulus was milk, increased, if it was the acid. (A prolonged influence of the gustative and especially of the food stimuli has been observed earlier by I. P. Pavlov.)

For a study of the effect of simultaneous introduction of acid and milk, or one stimulus 10 sec. after the other, the secretory method has proved to be inadequate, and the author's method of registering lip movements was used. A description of these reflexes is further given.

Experiments on the character of reciprocal influence between milk and sugar stimulation made in one dog did not result in salivary depression after either stimulus and no influence of one of these food reactions upon the other could be detected. In the other dog a defense reaction against the 10% sugar solution was observed, manifested in the distortion of the P/S coefficient and ending in the disappearance of salivation.

No other food or repellent stimuli could be tested, because the setting in of "Porfenov's reaction" (characterized by the dog's motor agitation and "spontaneous" salivation) disturbed the normal course of food and defense reactions.

Garibian, R. B., 1938a. O PISHCHEVYKH I OBORONITEL'NYKH SEKRETORNYKH I DVIGATEL'NYKH BEZUSLOVNYKH REAKTSII U SOBAK. SOOBSHCHENIE 3: SEKRETORNO-DVIGATEL'NYE PROIÁVLENIÍÁ PISHCHEVYKH I OBORONITEL'NYKH REAKTSII PRI VZAIMODEISTVII POSLEDNIKH [On unconditioned food and defense secretory and movement reactions in dogs. Communication 3: The secretory and movement manifestations of food and defense reactions and the interaction of these reactions]. Fiziol. Zhur. SSSR, 24 (3): 563-573.

The interactions of the following food and defense reflexes were studied in 3 dogs: 1. the defense reactions to acid, introduced into the mouth, and to electrical needle stimulation of the paw; 2. the food reaction to milk and the defense reaction to the electrical needle stimulation of the paw. The method is not described in this article. Results obtained are as follows:

If the electrical stimulation of the paw precedes the stimulation of 20 cc. of a 0.3% hydrochloric solution, the secretion of both the parotid and the submaxillary glands is increased; the coefficient P/S remains typical for defense reaction. If the electrical stimulation is applied simultaneously with the acid stimulation, or several seconds later, there is usually mutual depression of the secretory and the movement reflexes, or depression of either one of these reflexes.

If the electrical stimulation of the paw precedes the introduction of milk, parotid secretion is increased and submaxillary and sublingual secretions decreased; the coefficient P/S becomes typical for defense reaction. If the electrical stimulation is applied after the stimulation by milk, the submaxillary and sublingual secretions are increased, while the parotid secretion usually remains unchanged. If milk and the electrical stimulations are applied simultaneously, the reaction of all the three glands is depressed.

Garibian, R. P., A. G. Khripkova, K. E. Bugaev, I. N. Shepilo, B. K. Grebenkin, M. A.

Sukalo, A. D. Govorova, and N. N. Zainasheva, 1955. O NEIROGUMORAL'NOI REGULATSII SEKRETORNOI DEIATEL'NOSTI PISHCHEVARITEL'NYKH ZHELEZ [On the neurohumoral regulation of secretion from digestive glands]. In: VIII Vsesoiuz. S'ezd Fiziol., Biokhim., i Farmakol., Moscow, 1955, p. 159-160. Abst.: Sovet. med. refer. Obozrenie, Fiziol., 1956 (27): 79.

Investigations in the dog of the influence of castration on the defense and food reactions have shown that post-castration secretions of the parotid, submaxillary and sublingual glands in the male is sharply increased over the pre-castration standard. The lag periods after castration are shortened and the duration of secretion increased 0.5 to 2 hours; the maximum secretion rate in response to milk is advanced to the first hour; the external (simple) inhibition is also reduced; the other digestive secretions are equally increased. The absence of substantial changes in the Heidenhain ventricle in the gastric glands suggests that changes in the organism after castration occur by way of the central nervous system which acts primarily through the vagus nerve.

Gekker, I. V., 1937. ZUBNOI KAMEN' I ALVEOLIAMAIA PIORREIA [Dental calculus and pyorrhea alveolaris]. Stomatologiya, 3: 68-71.

Saliva was filtered into a very weak acetic acid solution, containing methyl orange indicator, to study the formation of dental calculus. The solution gradually became turbid as the neutral point was reached and the denaturated mucin precipitated as a gelatinous mist. Centrifugation and microscopic examination showed a large quantity of crystals, mainly calcium phosphate identified by their colorless, pointed rhomboid appearance. No precipitate appeared in control tubes containing distilled water. Calcium salts thus precipitate in the neutral medium formed at the contact of alkaline saliva with the acid surface of neglected and inactive teeth and in gingival pockets. The state of the salivary calcium salts is dependent upon the surrounding medium, being a colloidal suspension in alkaline medium and a solute in acid medium. Potentiometer determinations of the pH in gingival pockets of "dry" pyorrhea alveolaris, lacking in calcium deposit, was found to range from 5.3 to 6.2; this acid medium in the deep pocket, which produces greater destruction vertically and horizontally, keeps the calcium in solution and prevents calculus deposition. Supergingival and subgingival dental calculi are discussed.

Geller, J. H., and G. H. Rovelstad, 1957. SPECTROPHOTOMETRY OF SALIVA. Jour. dent. Res., 36 (5): 745-749.

In the spectral analyses of 200 saliva supernatants between 230 mμ wave length and 700 mμ wave length the typical absorption curves exhibited peaks at 280 mμ. In addition, many of the samples which were yellow in color exhibited peaks at 415 mμ with minor absorbances at 540 mμ and 575 mμ. The peaks at 280 mμ and 415 mμ were independent of each other and varied from case to case. The spectral analyses of the extract of numerous saliva sediments demonstrated a peak at 260 mμ. The peaks demonstrated by the spectra of saliva were reproduced at 280 mμ by 0.1 per cent protein (albumin) solution, at 260

mu by 0.05 per cent nucleoprotein (yeast), at 415 mu by 0.05 per cent hemoglobin (Bacto), and the hump at 290 mu by 0.5 mg. per cent uric acid. The height of all peaks was duplicated by known concentrations of solutes similar to those present in saliva. (Authors summary)

Geller, J. H., and G. H. Rovelstad, 1958. ELECTROPHORESIS OF SALIVA. *Jour. dent. Res.*, 37 (1): 27-28.

Samples of whole saliva, parotid saliva, and extra-parotid saliva were collected by paraffin stimulation. These samples were dialyzed against distilled water and then against veronal buffer (0.1 ionic strength, pH 8.6). After concentration the sample was analyzed. Six proteins were identified in the saliva samples and isoelectric points and mobilities at pH 8.6 determined. [An included table gives the isoelectric points, mobilities at pH 8.6 and type of saliva in which the following were identified: mucoid (Sialo), albumin, α -, β -, and γ -globulin, lysozyme.] The β -globulin (probably amylase) was present in greatest concentration in all fractions (an average 0.060 per cent in whole and extra-parotid and an average 0.033 per cent in parotid). The nonparotid samples were similar, averaging 0.021 per cent for mucoid and 0.027 per cent for albumin. Parotid samples averaged 0.022 per cent γ -globulin and 0.025 per cent lysozyme. (Author's abstract)

Gérard, E., 1897. EXAMEN CHIMIQUE DE LA SALIVE DANS UN CAS DE SIALORRÉE CHEZ UN ÉPILEPTIQUE [Chemical examination of the saliva in a case of sialorrhea in an epileptic]. *Compt. rend. de la Soc. de Biol. (Paris)*, 49 (37): 1017-1019.

A chemical analysis is given of the mixed saliva of an epileptic. The saccharifying power was greater than that of normal saliva. The ptyalin of this saliva was destroyed at the same temperature as that in normal saliva. The chemical composition, consistency and density of this saliva appeared to approach that of normal parotid saliva.

Gerry, Roger G., S. T. Smith, and M. L. Calton, 1952. THE ORAL CHARACTERISTICS OF GUAMANIAN INCLUDING THE EFFECTS OF BETEL CHEWING ON THE ORAL TISSUES. *Oral Surg.*, 5(7): 762-781; (8): 884-894; (9): 1004-1011.

The history, vital statistics, oral habits and hygiene, and dental treatment of the natives of Guam are discussed. The incidence of use of the betel nut, its properties, and its effect on oral structures is described.

It was determined that frequent betel nut chewers had an average salivary pH of 6.5 as compared with 6.1 for the non-chewing group. Chewing a betel nut for 2 minutes raised the pH of saliva 1.23 units; this increase in alkalinity was maintained for an average of 73 minutes after chewing.

The incidence of gingivitis is 11 per cent higher among betel chewers; the incidence of periodontoclasia is 12.4 per cent higher among chewers than non-chewers. This is probably due to the elevation of the pH of saliva which causes a more rapid precipitation of dental calculus. No cases of lichen planus and no chancres or mucous patches of syphilis were observed. Of

2004 individuals examined only 4 cases of leukoplakia were seen, and of 1836 cases of yaws only 1 primary lesion of the oral tissues was observed.

Gesell, Robert, 1918. OBSERVATIONS OF THE VOLUME FLOW OF BLOOD THROUGH THE SUBMAXILLARY SALIVARY GLAND. *Proc. Amer. physiol. Soc., Amer. Jour. Physiol.*, 45 (4): 545-546.

Observations were made of the volume flow of blood through the submaxillary gland under normal conditions and under circumstances of hemorrhage and tissue abuse. Under normal conditions of rest and constant blood flow the blood pressure remained constant, but upon increased glandular activity a linear increase in blood volume occurred.

Lowering the blood pressure, by induced hemorrhage and by tissue abuse, reduced the ratio of secretory blood flow to secretion, as well as the basal volume flow of blood; the greatest fall in basal volume flow of blood was produced by the initial decrease in blood pressure.

Gesell, Robert, 1918a. SOME ELECTRICAL PHENOMENA OF THE SUBMAXILLARY GLAND. *Proc. Amer. physiol. Soc., Amer. Jour. Physiol.*, 45 (4): 559-560.

The electrical variations of the submaxillary gland, submitted to different stimuli, were simultaneously measured with changes in the blood pressure, secretion, as well as the volume flow of blood. The resultant electrical deflection-responses and observations are discussed, and interpreted

Gesell, Robert, 1919. STUDIES ON THE SUBMAXILLARY GLAND. I. ELECTRICAL DEFLECTIONS IN GENERAL. *Amer. Jour. Physiol.*, 47 (4): 411-427.

A detailed technique is given for placing leads in the submaxillary glands of dogs for studying electrical deflections associated with stimulated salivary flow. The effect of changing leads, the strength of stimulus, the number of leads, etc., are presented.

Gesell, Robert, 1919a. STUDIES ON THE SUBMAXILLARY GLAND. II. AN AUTONOMIC AND BLOODLESS METHOD OF RECORDING THE VOLUME-FLOW OF BLOOD. *Amer. Jour. Physiol.*, 47 (4): 428-437.

A method is described for recording the volume flow of blood through the submaxillary gland in animals.

Gesell, Robert, 1919b. STUDIES ON THE SUBMAXILLARY GLAND. III. SOME FACTORS CONTROLLING THE VOLUME-FLOW OF BLOOD. *Amer. Jour. Physiol.*, 47 (4): 438-467.

By measuring the volume-flow of blood of the submaxillary gland of dog during prolonged chorda-stimulation, it was found that the synchronous fluctuations in secretion and electrical deflections were accompanied by parallel changes in volume-flow of blood. The possibility of the interdependence of the volume-flow of blood and the secretion are discussed in detail from the theoretical point of view.

Gesell, Robert, 1920. STUDIES ON THE SUBMAXILLARY GLAND. VI. ON THE DEPENDENCE OF TISSUE ACTIVITY UPON VOLUME-FLOW OF BLOOD AND ON THE MECHANISM CONTROLLING THIS VOLUME-FLOW OF BLOOD. *Amer. Jour. Physiol.*, 54 (1): 166-184.

The effect of varying the blood flow through the submaxillary gland on the rate of salivary secretion was observed in a study on dog concerning the dependence of tissue activity on the volume-flow of blood. Reduced blood flow (occluding carotid artery) during a short period of stimulation of the chorda tympani (10-30 sec.) did not decrease the secretion rate. Prolonged stimulation of the chorda tympani usually produced fluctuations in secretion during the period of stimulation. Whether stimulation was long or short, the volume-flow of blood and the secretion ran parallel with each other.

Gesell, Robert, 1920a. STUDIES ON THE SUBMAXILLARY GLAND. VII. ON THE EFFECTS OF INCREASED SALIVARY PRESSURE ON THE ELECTRICAL DEFLECTIONS, THE VOLUME-FLOW OF BLOOD AND THE SECRETION OF THE SUBMAXILLARY GLAND OF THE DOG. *Amer. Jour. Physiol.*, 54 (1): 185-203.

In this paper on the physiology of the salivary glands, the effects of increased salivary pressure upon secretion of the submaxillary gland was studied in the dog. Increased salivary pressure was produced by occluding the salivary duct and by backward injection into the duct of gum-saline. It is concluded that:

"De-occlusion of the salivary duct during secretion elicited by the injection of pilocarpin was followed by a short period of accelerated secretion. This accelerated secretion never compensated fully the absence of secretion during the period of occlusion.

"De-occlusion of the duct several minutes subsequent to injection of gum-saline into the duct was followed by an after-flow from the duct of 0 to 4 drops.

"Occlusion of the salivary duct along with stimulation of the chorda tympani was followed upon de-occlusion by a secretion less in amount than that normally elicited with the duct unoccluded. The amount of saliva unaccounted for varied considerably with the animal, the duration of occlusion and the amount of secretion obstructed.

"De-occlusion of the duct after obstructing for several minutes a temporary secretion elicited by stimulation of the chorda tympani may be followed by a slow secretion lasting 4 to 5 minutes.

"Occlusion of the duct during secretion elicited by the stimulation of the chorda tympani increased the amount of saliva elicited by subsequent stimulation of the chorda tympani or vago-sympathetic. The latent period of secretion was also reduced by several seconds.

"Backward injection of gum-saline into the resting gland increased the amount of secretion elicited by subsequent stimulation of the chorda tympani or vago-sympathetic and reduced the latent period of secretion.

"Injection of atropin sufficient to check secretion elicited by the stimulation of the chorda tympani or vago-sympathetic may fail to prevent secretion with similar stimulation after backward injection into the salivary duct.

"The effects of occlusion of the duct upon secretion elicited by stimulation of the chorda tympani suggests that secretion may occur in two definite stages. The effects of atropin on augmented secretion following backward injection of gum-saline into the duct suggests the same inference." (From the author's summary.)

Gesell, Robert, 1920b. STUDIES ON THE SUBMAXILLARY GLAND. VIII. ON THE EFFECTS OF ATROPIN UPON VOLUME-FLOW OF BLOOD, ELECTRICAL DEFLECTIONS AND OXIDATIONS OF THE SUBMAXILLARY GLAND. *Amer. Jour. Physiol.*, 54 (1): 204-215.

The effects of intravenous injection of atropine on salivary secretion, blood flow, and electrical changes in the submaxillary gland upon chorda tympani stimulation were studied in dogs.

Injection of 1.5 mg. of atropine abolished both the secretion and the electrical deflections elicited by stimulation of the chorda tympani.

The effects of repeated injection of small amounts of atropine were observed, each injection occurring several minutes before stimulation of the chorda. Before the atropine injection, stimulation of the chorda elicited a copious salivary secretion, a copious flow of blood, and a large electrical deflection. Following administration of 1 mg. atropine, the same flow of blood was observed, but the secretion was reduced to only 1/2 drop and the electrical deflection was nearly abolished. When subsequent injections were made of 4, 7, 9, and 50 mg., the secretion and electrical response of the gland continued to be absent. In another series, administration of 0.08 mg. of atropine almost paralyzed secretion: only 1 drop was elicited as compared with 6 drops before atropinization. The flow increase of the blood was also reduced, but the electrical deflection was very distinct.

The strength of stimulation was graduated in two ways: mechanically by regulating the strength of the shock delivered by the induction coil and physiologically by reducing the effectiveness of stimulation of constant strength by the injection of graded doses of atropine. A comparison of the electrical, secretory, and vasomotor response of the gland with these two methods of gradation of stimulation was made in 2 animals. The chorda tympani was stimulated at regular intervals with stimuli of equal duration; the strength of the stimulus was increased until an arbitrary maximum was found. Small amounts of atropine (0.05 mg.) were injected prior to each stimulation. Each increase in strength of stimulation resulted in an increase in the amount of secretion and a decided change in the electrical deflection. After the maximum strength of stimulation was reached each injection reduced the amount of secretion, but elicited just as marked changes in the electrical deflection.

It was concluded that a small injection of atropine may abolish visible secretion as normally elicited by chorda stimulation, and yet permit activation of the gland as indicated by the marked electrical deflection which may occur in the absence of visible secretion.

Gibbs, O. S. and J. Szelöczey, 1932. DIE HUMORALE ÜBERTRAGUNG DER CHORDA TYMPANI REIZUNG. [The humoral transmission of the chorda tympani stimulation]. *Naunyn-Schmiedeberg's Arch. exper. Pathol. und Pharmakol.*, 168 (1): 64-88.

A method of artificial perfusion of various organs is discussed. The trachea, the lingual artery, and the femoral vein of chloralosed cats and dogs were cannulated and the vagus nerve severed. A type of Ringer solution [Merck's Universal Indicator] was used as the perfusion solution at a temperature of 37°C. The stimulation of the chorda was carried out by platinum

electrode. Salivary secretion was registered with Gibbs' droplet counter. The following results were noted: when 1/4 mg. physostigmine was injected into the femoral vein of the cat after stimulation of the chorda, the perfusion fluid contained a substance which seemed to decrease blood pressure; the greatest drop in blood pressure occurred after 30 seconds of chorda stimulation. The greatest amount of chorda substance secreted corresponds to 0.05 acetylcholine. This substance which reduced the blood pressure of the submaxillary gland of the cat, and was identified in the isolated heart of the frog and the intestine of the rabbit, proved to behave identically with acetylcholine and with wagusstoff [a substance produced by the stimulated mixed nerve]. The action of the chorda substance was inhibited by the administration of physostigmine. It is assumed that the chorda substance is an ester displaying the same activity as acetylcholine itself.

Gibbs, O. S., 1935. ON THE ALLEGED OCCURRENCE OF ACETYLCHOLINE IN THE SALIVA. *Jour. Physiol.*, 84 (1): 33-40.

In opposition to the findings of Secker (cf. Secker, 1934m,n), a series of experiments on cats produced no indication of the presence of acetylcholine in saliva. Injection of fresh saliva, produced by either nerve stimulation or acetylcholine injection, with or without physostigmine, caused a marked drop of blood pressure; in some cases, there was a sharp preliminary rise. However, the type of graph produced by fresh saliva differs from that produced by acetylcholine injection. Effects of atropine injection after injection of fresh saliva were varied: atropine sometimes obliterated the depressor effects of acetylcholine and sometimes not. Injection of saliva into the salivary gland artery did not evoke secretion, but consistently caused a reduction in that produced by added acetylcholine.

Gibbs, O. S., and H. H. McClanahan, 1937. THE EFFECT OF HISTAMINE ON SALIVARY SECRETION. *Jour. Pharmacol. and exper. Therap.*, 61 (3): 218-229.

Experimental studies in cats of salivary secretory stimulants reveal that intro-arterial injections of histamine or acetylcholine can cause the production of a secretion; salivation parallels the duration of administration of the agents.

Findings indicate that histamine has an acetylcholine-like relationship with atropine and physostigmine: atropine annuls the action while physostigmine increases the secretagogue effects of histamine. However, histamine is not physostigmine-like in its activity.

Histamine injections rarely or never potentiate the effects of acetylcholine, but experimentally increase the physiological effects of chorda stimulation. The latter indicates an indirect action of histamine as a secretory agent possibly acting to enhance, by prolongation, the effects of stimulation of cholinergic nerves.

Gies, William J., and Emily C. Seaman, 1910. REPORT TO COMMITTEE ON SCIENTIFIC RESEARCH, [Dental Society of the State of New York]. *Dental Cosmos*, 52 (10): 1141-1145.

Various percentages of potassium thiocyanate (0.0006, 0.012, 0.024 and 0.048) were added to a meat broth medium which had been inoculated with

saliva containing oral bacteria (gram positive; acid producing) obtained from carious teeth. Incubation for 24 hour periods produced bacterial growth and a gelatinous plaque in all cases. It is concluded that KCNS in amounts greater than those that occur in saliva has no marked inhibitory influence on growth of salivary bacteria or on formation of bacterial plaques. Bacterial growth and plaque formation was inhibited in a second series of experiments using the same inoculated broth stock on addition of various concentrations of either oil of cassia or carbolic acid. Addition of 1 cc. of a 0.06% solution of KCNS to a similar series of culture tubes resulted in bacterial growth in broth containing 0.05% carbolic acid. Bacterial plaques failed to develop in all tubes of this series. It is suggested that KCNS may act to stimulate bacterial growth. The inoculated stock medium, with and without addition of .006% glucose, used in further experiments, showed bacterial growth, decalcification of suspended teeth, but no plaque formation after 2 weeks of incubation. Substitution of .0006% KCNS for the glucose produced somewhat similar results while substitution of meat or gelatin resulted in putrefaction of the meat and the formation of non-adherent plaques. Other experiments using sterile saliva, or mucin precipitated from saliva either by alcohol or by acetic acid showed bacterial growth and non-adherent plaques present. In cases where teeth were used in this last series, decalcification was noted when acetic acid-precipitated mucin was used but not when the mucin was alcohol-precipitated.

Gies, William J., and Max Kahn, 1913. AN INQUIRY INTO THE POSSIBLE RELATION OF SULFOCYANATE TO DENTAL CARIES. *Dental Cosmos*, 55 (1): 40-53.

An analysis of various organs of 6 completely exsanguinated dogs showed no thiocyanate to be present in the salivary glands. This agreed with previous observations as to the lack of this substance in dog saliva. Similar experiment showed thiocyanate to be present in the salivary glands of an ox. Controlled diet experiments on dogs indicated that thiocyanate is produced in the liver as a waste product. The authors conclude that in some cases the salivary glands may excrete rather than secrete thiocyanate. Tests were conducted on the inhibitory effects of thiocyanate on mixtures of common bacteria and fungi cultivated in gelatin and gelatin-peptone media. Concentrations greater than 3% inhibited growth of the bacteria but not of the fungi which grew luxuriantly in concentrations of 10% thiocyanate. Yeast in a 5% glucose solution also grew well at this concentration. Concentrations of 0.5% or more inhibited development of lactic acid bacilli [*Lactobacillus lactis*] in milk.

Gies, William J., C. C. Lieb, and M. Kahn, 1914. A FURTHER STUDY OF SULFOCYANATE IN ITS POSSIBLE RELATION TO DENTAL CARIES. *Dental Cosmos*, 56 (2): 175-197.

A study was made of the relation of salivary sulfocyanate to dental caries. The chemical and anatomical origin and the pharmacology of the drug were investigated in men and animals. It is concluded that salivary sulfocyanate is an excretory, rather than secretory, product. No indication was found that the drug, in the normal proportion found in saliva, affects the secretory

tendencies of the salivary glands, modified the oral membranes, or alters the activities of the oral bacteria.

Gies, William J., 1916. AN INTERESTING FACT REGARDING THE REACTION OF SALIVA TO PHENOLPHTHALEIN. *Jour. Allied dent. Soc.*, 11 (2): 273-274.

While comparing the acidity of various salivary specimens, it was noted that the solution resulting from filtration often reacted alkaline to phenolphthalein even though the samples were previously demonstrably acid. It is concluded that acid mucinate is present in saliva as a colloidal suspension, and that when a filtration is made the mucinate remains on the filter to give an acid reaction while alkaline phosphate passes through as the filtrate.

Gies, William J., and collaborators, 1916a. FURTHER NUTRITIVE STUDIES OF DENTITION. 1. STUDIES OF INTERNAL SECRETION IN THEIR RELATION TO THE DEVELOPMENT AND CONDITION OF TEETH. 2. EFFECTS OF FEEDING GLANDULAR TISSUES, PREPARATIONS AND EXTRACTS. *Jour. Allied dent. Soc.*, 11 (1): 47-69.

Prolonged experiments, in which preparations of 12 glandular materials were fed to young albino rats, indicated that the calcium portions of the total solid and ash fractions of the incisor teeth were indirectly or directly affected by the administration of the glandular substances. Of the substances tested, the pineal, salivary, and thyroid preparations significantly decreased, and testicular administration increased the calcium proportions.

Gies, William J., 1916b. FURTHER REMARKS ON THE VALIDITY OF MARSHALL'S "SALIVARY FACTOR" FOR THE BIOCHEMICAL DETERMINATION OF SUSCEPTIBILITY TO, OR IMMUNITY FROM DENTAL CARIES. *Jour. Allied dent. Soc.*, 11 (3): 488-516.

A continuation of a previous article (Shepard and Gies, 1916) is presented which critically discusses the deductions, postulations, and conclusions of Marshall which pertain to his salivary factor.

Gies, William J., 1916c. SUPPLEMENTARY COMMENT ON THE VALIDITY OF MARSHALL'S "SALIVARY FACTOR." *Jour. Allied dent. Soc.*, 11 (4): 659-667.

A discussion is presented concerning Marshall's reply (1916n) to previous critical examinations of his salivary factor theory.

Gies, William J., 1917. ADDITIONS TO THE DISCUSSION OF THE SIGNIFICANCE OF MARSHALL'S SALIVARY FACTOR. *Jour. Allied dent. Soc.*, 12 (1): 65-84.

A critical discussion is given concerning Marshall's salivary factor.

Gies, William J., and collaborators, 1917a. NEW FINDINGS IN STUDIES OF THE VALIDITY OF MARSHALL'S SALIVARY FACTOR AS A MEANS OF DIAGNOSIS OF DENTAL CARIES. *Jour. Allied dent. Soc.*, 12 (2): 212-218.

Results of tests repeating Marshall's experiments confirm the findings of Shepard and Gies (1916), and further prove that Marshall's salivary factor is not a satisfactory index for indicating caries susceptibility.

Gies, William J., et al., 1917b. STUDIES OF INTERNAL SECRETIONS IN THEIR RELATION TO THE DEVELOPMENT AND CONDITION OF THE TEETH. *Dental Cosmos*, 59 (12): 1238-1241.

A glyco-protein found in teeth has been shown to be similar to the mucoid substance found in bone. The protein is considered analogous to but not identical with salivary mucin.

Gilda, J. E., and P. H. Keyes, 1947. INCREASED DENTAL CARIES ACTIVITY IN THE SYRIAN HAMSTER FOLLOWING DESALIVATION. *Proc. Soc. exper. Biol. Med.*, 66 (1): 28-32.

Surgical desalivation of 7 hamsters (3 males, 4 females) resulted in a definite loss of body weight and an increase in dental caries which, however, was not significant in the males but warrants further study. In two groups of treated control animals (one comprising 4 males and 5 females, and other 8 males and 9 females), dental caries was more prevalent in males than in females.

Gilkerson, S. W., H. F. Brown, and G. H. Rowelstad, 1958. A MICROSCOPIC STUDY OF THE SALIVA SEDIMENT. *Jour. dent. Res.*, 37 (1): 26-27.

The phase contrast microscopic examination of the sediment of saliva in a study of dental caries-free young adults has revealed a definite cytology. Several distinct cell types, other than epithelial cells which have been described as a part of the salivary corpuscle system, have been observed with regularity. These cells have been noted to have diameters ranging from 10 to 18 microns when observed in the living state. (Author's abstract)

Ginn, J. T., and J. F. Volker, 1942. RUSTING IN DESALIVATED ALBINO RATS. *Endocrinol.*, 31 (2): 282-283.

The effect of salivary gland extirpation on the general development of the rat was studied. Three groups of albino rats, each consisting of 6 males and 6 females, were placed on a milk diet (i.e., equal parts of distilled water and evaporated milk, fortified with copper, iron and manganese) and the function of the salivary glands in various states was observed. Group I consisted of control animals; in Group II, the skin above the salivary glands was excised, the glands exposed but left intact; and in Group III, the salivary glands were removed.

After 3 to 6 weeks, rusting of the fur occurred in Group III, being more pronounced in females than in males. The authors attribute the condition to a "disturbance of the normal relationship between the vitamin B complex and the sex hormones by the removal of the salivary glands."

Giri, K. Venkata, 1936. ÜBER SPEICHEL-PHOSPHATASE [Salivary phosphatase]. *Biochem. Zeitschr.*, 285 (5-6): 306-310.

Phosphatase content of human saliva was determined. Paraffin saliva was diluted and centrifuged. Then, sodium glycerophosphate combined with 10 cc. buffer solution was added. Hydrolysis was carried out at 37° C. The obtained phosphate, as well as the reaction-mixture were measured by colorimetric method. Changes in decomposition of sodium glycerophosphate and sodium hexosediphosphate observed at various hydrogen ion concentrations

have shown that the optimum pH for phosphatase was 4.0 to 5.0 for the hydrolysis of the former compound, and pH 7.0 for the same process with the latter sodium compound. Dialysis had slight effect on salivary phosphatase. To explain these phenomena, the presence of an anticatalyst in the saliva was assumed. By dialysis the anticatalyst was removed and the enzyme content remained rather stable. Magnesium ions did not activate the phosphatase at pH 5.0 and inhibited it at higher concentrations. A slight activation was seen at pH 8.5. Salivary and urinary phosphatase seemed to be identical, and acid phosphatase seemed to be typical for body fluids and secreta. Sodium hexosediphosphate was easier to hydrolyze by salivary phosphatase than sodium glycerophosphate.

Giri, K. V., A. L. N. Prasad, S. G. Devi, and J. S. Ram, 1952. A TECHNIQUE FOR THE IDENTIFICATION AND SEPARATION OF ENZYMES BY PAPER CHROMATOGRAPHY. *Biochem. Jour.*, 51 (1): 123-128. A paper chromatographic technique is presented for the comparative identification of the amylases of saliva, sweet potato, rice, and *Aspergillus niger*, as well as of phosphatase and phosphorylase. Known volumes of the enzymes were placed in circumscribed areas on filter paper and the spots were allowed to dry. n-Butanol was employed as the solvent and the chromatogram was allowed to run until the solvent had advanced 20 cm. from the starting point, after which the limits were marked. Iodine and an agar-substrate medium + 0.067 M-phosphate buffer were used for the identification of the salivary enzyme. Chromatographic positions of the enzymes were noted by the formation of colorless or colored areas on the agar plates, beta and alpha amylase forming violet and colorless spots respectively on the blue background. Aqueous acetone and sodium chloride solutions were the best of the developing agents investigated.

The movements of the various enzymes were studied individually, in mixtures, and in extracts from animal and plant tissues. Salivary amylase, unlike that of *Aspergillus*, showed no movement with any of the solvents used. The chromatogram of a mixture of salivary and sweet potato amylases was so complex in shape that their separation and identification was difficult.

Glass, Robert L., 1951. THE OCCURRENCE OF YEASTS IN THE SALIVA OF CHILDREN. *Jour. dental Res.*, 30 (4): 468.

"Stimulated saliva samples were collected from 348 children, 7 to 14 years of age, whose caries activity during the past year was known. One half cubic centimeter portions were plated on Sabouraud's dextrose agar; colony counts were made after 48 hours incubation at 37° C. Yeasts were found in 156 cases, a 45 per cent occurrence, in counts up to 12,000 per cubic centimeter of saliva. *Candida albicans* predominated; *Cryptococci* and *Saccharomyces* strains were found occasionally. There was no correlation between yeasts and lactobacilli counts. A significant correlation was found between the presence of yeasts and the incidence of dental caries." (Complete paper.)

Glass, Robert L., 1952. THE LACK OF RELATIONSHIP BETWEEN SALIVARY LACTOBACILLUS COUNTS AND DENTAL CARIES ACTIVITY. *Oral Surg.*, 5 (2): 210-213.

Salivary lactobacillus (*Lactobacillus acidophilus*) counts were made on 351 school children, aged 7 to 14, together with an examination for caries activity; the procedure was repeated 1 year later. The results indicate no trend for lactobacilli counts to increase with an increase in the number of newly decayed and filled teeth.

Glavind, Johs., Humberto Granados, L. Alfred Hansen, Kurt Schilling, Inger Kruse, and Henrik Dam, 1948. THE PRESENCE OF VITAMINS IN THE SALIVA. *Internationale Zeitschr. f. Vitaminforsch.* 20 (1/3): 234-238. In English, with German and French summaries, (p. 237).

The salivas of 8 healthy persons between 18 and 30 years of age were studied for vitamin content.

The presence of B vitamins (determined by microbial assay) and the amount in which they occurred were as follows: Thiamin (as hydrochloride), 0.007 micrograms/ccm. fresh saliva; riboflavin, 0.05; nicotinic acid, 0.03; pyridoxin (as hydrochloride), 0.6; pantothenic acid, as Ca-salt, 0.08; folic acid, 0.0001; and biotin, 0.0008.

Two determinations of vitamin C (color reaction devised by Roe and Kuether, *Jour. biol. Chem.*, 147: 399. 1943, modified by Bolomey and Kemmerer, *Jour. biol. Chem.*, 165: 377. 1946.) showed an average ascorbic acid content in saliva of 2.4 γ per cc. Four determinations of the ascorbic acid content of paraffin-stimulated saliva averaged 1.7 γ/cc.

Vitamin K determinations (method described, but not considered suitable for very exact quantitative study) indicated that the figures were of the same magnitude as those of other body fluids and tissues: a decrease in prothrombin time occurred in both chicks after ingestion of dried saliva, to the extent that an average of both sets of figures showed that the tested saliva had a vitamin K content corresponding to the activity of about 2.5 γ of menadione per gram of dried saliva (or to 1.5 γ /100 cc. fresh saliva)

Glazko, Anthony J., and David M. Greenberg, 1939. THE MECHANISM OF THE ACTION OF SALIVA IN BLOOD COAGULATION. *Amer. Jour. Physiol.*, 125 (1): 108-112.

Results of investigation on the acceleration of blood coagulation by saliva indicate that saliva contains a thromboplastic substance, a protein which is apparently cellular in origin. Fresh filtered saliva was found to have only a slight coagulating effect on fibrinogen. Using Ferguson's method (*Amer. Jour. Physiol.*, 117 (4): 587-595, 1936), the thromboplastic activity of saliva was assayed: sediment from centrifuged saliva was found to be highly active in thromboplastic properties; the supernatant fluid had considerably less thromboplastic power. Saliva lost its thromboplastic property in a few days if left liquid; dried in a vacuum oven it retained this power with little loss of activity.

Heating to 100°C enhances, during the first few minutes, the activity of whole or centrifuged saliva. Continued heating results in a gradual loss that is practically complete after 10 minutes.

Saliva was dialyzed for 24 hours in cellophane bags against running distilled water without loss

of activity. Activity was increased by ultrafiltration. The active material was precipitated by saturating the saliva with ammonium sulfate and could be recovered from the precipitate, suggesting a protein nature of the coagulation-accelerating material. Ether or benzene extracts of saliva showed no thromboplastic activity while residues from the extracts were not as active as the original substance. The author suggests that the active material may be a lipoprotein.

Gley, E., 1888. ACTIONS D'ARRÊT SUR LA SÉCRÉTION DE LA GLANDE SOUS-MAXILLAIRE [Inhibitory effects on secretion of the submaxillary gland]. *Compt. rend. de la Soc. de Biol. (Paris)*, 40 (38), *Compt. rend.*, p. 812-813.

Galvanic excitation of the sciatic nerve of the dog normally produces a marked secretion of the submaxillary gland. If the chorda tympani of the moderately curarized dog is first stimulated by galvanic current to elicit submaxillary saliva, stimulus applied to the sciatic within 3-4 seconds has no effect upon the flow produced by chorda stimulation. If the time interval between administration of the two stimuli be increased to 6 seconds, both elicit saliva. The author considers that the submaxillary gland during its period of activity is not excitable by additional stimuli.

Gley, E., 1911. L'ADRENALINE EXERCE-T-ELLE UNE ACTION ANTAGONISTE DE CELLE DES ALBUMOSES OU DE LA PILOCARPINE SUR LES SÉCRÉTIONS PANCRÉATIQUE ET SALIVAIRE? [Does adrenaline exercise an antagonistic effect on albumose or pilocarpine in pancreatic and salivary secretions?]. *Compt. rend. de la Soc. de Biol. (Paris)*, 71 (24): 23-27.

Experiments on dogs under chloralose anesthesia showed that adrenaline had no specific antagonistic effect on pilocarpine or Witte's peptone injections. Injection of adrenaline, after pilocarpine or peptone had induced secretion, caused a slackening of the secretion during the phase of maximum arterial pressure but did not alter the total amount secreted. Injection of adrenaline before injection of peptone did not cause any lessening of the rate of secretion induced by peptone.

Gley, E., and Maurice Mengelsohn, 1915. QUELQUES EXPERIENCES SUR LE REFLEXE SALIVAIRE CONDITIONNEL CHEZ L'HOMME [Some experiments on the conditioned salivary reflex in man]. *Compt. rend. de la Soc. de Biol. (Paris)*, 78 (19): 645-649.

An attempt to induce conditioned reflex salivation in a hospitalized soldier by sight of preferred food, associated sound, or light was unsuccessful.

Gley, E., and Alf. Quinquaud, 1921. PERSISTANCE, APRES LA SURRÉNALECTOMIE DOUBLE, DU REFLEXE SALIVAIRE CAUSE PAR L'EXCITATION DU NERF SCIATIQUE [Persistence, after double adrenalectomy, of the salivary reflex caused by excitation of the sciatic nerve]. *Compt. rend. de la Soc. de Biol. (Paris)*, 84 (14): 706-708.

Removal of adrenal glands of 7 dogs caused a diminished submaxillary gland saliva response to sciatic nerve stimulation during the first fifteen minutes after adrenalectomy. Then the amount of saliva elicited by nerve stimulation returned to that obtained before the adrenalectomy,

providing the body temperature of the dog did not drop.

Glezer, D. I. A., 1949. PRISPOSOBLENIE DLIA ZAPISI SLIUNOOTDELENIIA SOBAKI, SVOBODNO PEREDVIGAIUSHCHEISIA PO LABORATORNOI KOMNATE. [Apparatus for registration of the salivary secretion in the dog, moving freely about the laboratory room]. *Fiziol. Zhur. SSSR*, 35 (4): 476-477.

A new apparatus for automatic electrical registration of salivary secretion from the parotid gland is described, permitting free movement of the animal, and simultaneous registration of the secretions of several dogs conducted by one operator.

Glock, Gertrude E., 1936. AN INVESTIGATION OF THE RATES OF DIGESTION OF STARCHES AND GLYCOGEN AND THE BEARING ON THE CHEMICAL CONSTITUTION. I. ACTION OF AMYLASES ON STARCHES AND GLYCOGEN. *Biochem. Jour.*, 30 (8): 1386-1396.

The in vitro digestive processes of salivary amylase, takadiastase, malt diastase, and "Holladin's solution" (pancreatic amylase) were quantitatively followed on glycogen and several starches: maize, wheat, potato, and rice. The rates of polysaccharide disappearance, the achromic points, the formation of maltose and reducing dextrin, and maltose formation (alone) were observed and evaluated.

Findings indicated that the rates of hydrolysis vary according to the material used, and that the rates of glycogen hydrolysis were always lower than those of the starches. In all cases the same end products were formed. Glucose, however, did not appear as a hydrolytic product unless a large quantity of enzyme was used.

Several theories are discussed which attempt to account for the different rates of starch hydrolysis, none of which are considered satisfactory.

Glock, Gertrude E., and Margaret M. Murray, 1938. CHEMICAL INVESTIGATION OF SALIVARY CALCULUS. *Jour. dental Res.*, 17 (4): 257-264.

"1. A study has been made of the inorganic and organic material of salivary calculus. 2. The inorganic material (82.9 per cent) is made up of calcium and magnesium phosphates (79.7 per cent) and calcium carbonate (3.2 per cent). 3. There is 8.34 per cent protein present. This is found to consist of keratin, mucin and nucleoprotein (or nucleic acid). There is also 2.7 per cent fat. 4. Spectrum analysis revealed the presence of small amounts of Cu, Ag, Na, Sn and traces of Zn, Al, Ba, Sr and possibly Cr. 5. X-ray crystallographic analysis gave poor results. Salivary calculus is largely amorphous, though probably in part "apatite" like in structure." (Author's summary.)

Glock, G. E., M. M. Murray, and P. Pincus, 1938. THE ORIGIN AND SIGNIFICANCE OF SALIVARY PHOSPHATASE. *Biochem. Jour.*, 32 (12): 2096-2104.

A comparison was made of the phosphatase activity of "native", of centrifuged, and of filtered saliva (seven samples each). Two native saliva samples lacked phosphatase activity; all 5 samples of centrifuged saliva tested showed some activity; and 3 of the 4 filtered salivas examined were void of phosphatase activity, the 3 active samples being non-sterile (Berkefeld

filtered) and the 1 inactive sample, sterile (Seitz filtered). It seems that the phosphatase activity may be due to the presence of microorganisms.

On the assumption that cannulated saliva collected under sterile conditions is microbe-free, a comparison was made of the phosphatase activity of cannulated and of normal pilocarpine-stimulated saliva of two cats. A slight activity was observed in the cannulated saliva, attributable either to the presence of cells or to direct secretions of the glands.

A series of comparisons of the phosphatase activity of saliva obtained directly from the mouth and uncontaminated with air-borne organisms, and the activity of the same saliva, incubated in a nutrient medium at 37° C., showed a direct relation between the phosphatase activity and an increase in the number of microorganisms.

The author concludes, from the foregoing experiments, that the microorganisms present in saliva could be responsible for the phosphatase activity.

The relation of calculus (tartar) to microorganisms and salivary phosphatase was studied. The phosphatase activity of five microorganisms, *Penicillium spinulosum* (Thom.), a species of *Rhodotorula*, a monilia, *Actinomyces buccalis* (Winslow), and *Actinomyces* (Group I, Erikson), was studied on different substrates of various pH, Na- α -glycerophosphate, Na- β -glycerophosphate, and di-Na-phenyl phosphate. At a pH of 5.5, the greatest activity was exhibited by *P. spinulosum* in all 3 substrates, and by *Actinomyces* in the Na- α -glycerophosphate. Some activity was seen in monilia, *Rhodotorula*, and a mixed culture of monilia and *P. spinulosum*, in all substrates. The author concludes that certain mouth organisms, including *Actinomyces*, are capable of exhibiting phosphatase activity in the mouth.

When studied on substrate of blood and saliva, the *Penicillium* was able to utilize the hydrolyzable ester phosphate of both.

When extracts of *Penicillium* were incubated with a 1% solution of calcium glycerophosphate, a white precipitate was formed; the precipitate containing Ca and P, was soluble in acid. The author believes this phenomenon may be analogous to calculus formation.

Goaz, Paul W., 1955. A METHOD TO STUDY THE ROLE OF SALIVA IN THE CARIOUS PROCESS. Jour. Dental Res., 34 (5): 690.

The effect of saliva on the decalcifying activity of lactobacillus was studied in human saliva, sterilized with ethylene oxide prior to incubation with a powdered tooth substance, and an oral lactobacillus culture suspended in a glucose solution. The amount of soluble Ca formed is used as an index. Calcium values obtained with ethylene oxide-sterilized saliva were 2 to 4 times greater than those obtained with autoclaved saliva, and 2 to 6 times greater than those obtained with Seitz-filtered saliva.

The salivas of 5 persons with endocrine disorders were studied during therapy. Increased decalcifying activity of the lactobacilli was noted in the incubated salivas of 2 hypothyroid patients receiving increasing amounts of thyroxin. Increased decalcifying activity was also noted in the saliva of a 15-year old boy with delayed adolescence, at the onset of puberty following chorionic gonadotropin therapy. Decreased decalcifying activity was noted in the salivas of 2 hyperthyroid patients being treated with radioiodine and thyroidectomy. (From author's abstract)

Gochman, N., R. Q. Blackwell, and L. S. Fosdick, 1958. AMINO ACID DECARBOXYLASES IN THE SEDIMENT FROM INCUBATED SALIVA. Jour. dent. Res., 37 (1): 30-31.

Salivary bacteria, cultivated under varying conditions, were tested for the presence of non-oxidative amino acid decarboxylases. Nonincubated saliva as well as acetone-extracts, obtained from glucose-casein digest cultures, showed no detectable activity. Aerobic incubation of whole saliva, in the presence of casein hydrolysate for several hours, yielded a sediment which exhibited decarboxylase activity. The presence of glucose inhibited the development of the decarboxylases. The washed sediment was tested on 17 amino acids used as substrates. Arginine, ornithine, glutamic acid, histidine, and lysine were consistently decarboxylated, with no measurable activity on the other amino acids. Determinations were performed using a manometric estimation of CO₂ evolution under N₂ atmosphere. The pH optimum was 6.5 for each of the 5 amino acids, considerably more alkaline than that reported for other bacterial amino acid decarboxylases. A study was made of the relative distribution and activity of the decarboxylases in saliva obtained from normal and periodontal patients. The diseased patients showed appreciably greater total decarboxylase activity than the normals. However, the distribution of amino acid decarboxylases in all saliva samples remained relatively constant, with ornithine accounting for about 50 per cent of the total CO₂ evolved. (Author's abstract)

Godelfer, Lucille, 1947. DENTAL CARIES. Amer. Jour. med. Technol., 13 (1): 18-24.

A review of the literature indicates that the definite etiological agent in caries is *Lactobacillus acidophilus*. The procedure for a quantitative estimation of the number of *L. acidophilus* in saliva is presented. The lactobacilli are described as a pleomorphic group; a cultural and morphological description is given of four distinct types. As oral lactobacilli do not grow in human saliva in the absence of sugar, a reduction in the carbohydrates intake decreases the number of lactobacilli and hence caries activity.

Goding, G. J., and D. A. Denton, 1956. ADRENAL CORTEX AND THE PAROTID SECRETION OF SODIUM-DEPLETED SHEEP. Science 123 (3205): 986-987.

The effect of adrenal steroids on the ionic Na/K ratio in the parotid saliva was studied in sheep having a modified Pavlov-Glinski fistula of the parotid duct. Such sheep have been found to lose saliva (2-4 L./day) and to incur Na depletion with a resultant drop in the parotid Na/K balance from 18 to 0.1.

Intramuscular injection of desoxycorticosterone (DOCA), 20 mg./day for 2 days, in a sheep having a parotid fistula and showing moderate Na depletion, resulted in definite change in the salivary Na/K ratio. A similar injection in a grossly Na-depleted animal caused less than a 5 mEq/L. effect in ionic concentration.

In further studies conducted in sheep having a unilateral parotid fistula and bilateral adrenalectomy, parotid saliva was found normal if the sheep were given adequate Na replacement in addition to daily doses of 5-10 mg. of DOCA and 25 mg. of cortisone. Replacement of the Na+ alone caused a drop in the serum Na/K ratio and a rise in the salivary Na/K ratio; the animal deteriorated rapidly. Injection of the adrenal hormones

caused a drop in the salivary Na/K ratio to a level consistent with the degree of Na depletion. If the DOCA injection were increased from 5 mg. to 40 mg./day the salivary Na/K ratio fell from 1.7 to 2.0 in 5 days.

The administration of hormones alone produced renal insufficiency in 2 to 4 days but no change in the salivary ratio, although Na depletion had occurred. The administration of hormones alone with an increased dose of DOCA (20 mg./day) was followed by a drop in salivary Na/K ratio similar to that occurring in adrenal-intact sheep with Na depletion. Restoration of the Na balance was followed by a rise in the salivary ratio. Adrenal steroids are considered to modify the salivary Na/K ratio, the hormones' acting as one of 2 or more factors to control parotid behavior in normal animals.

Goldberg, Hyman J. V., J. Edward Gilda, and Garson H. Tishkoff, 1948. PAPER PARTITION CHROMATOGRAPHY: FREE AMINO ACIDS IN SALIVA. A PRELIMINARY REPORT. Jour. dental Res., 27 (4): 493-496.

Paraffin-stimulated saliva was examined for free amino acid contents by paper partition chromatography.

Saliva samples of 20 ml. each from each test individual were pooled and transferred to cellophane bags which were a component of an ultra-filtration system. The ultra-filtrate was dehydrated. In each run, a portion of the dried ultrafiltrate (equivalent to 5 ml. whole saliva) was dissolved in a minimum quantity (100 microliters) of distilled water and analyzed by 1 and 2 dimensional chromatography. (Method is described in detail).

The presence in saliva of 13 free amino acids was determined: glutamic acid, aspartic acid, glycine, alanine, methionine (sulfoxide), arginine, leucine, lysine, phenylalanine, taurine, tyrosine, valine, and proline.

The alimination of interferences of other nitrogenous substances, particularly peptides, presents a distinct advantage of this method over those previously used.

Goldberg, Hyman J. V., and Basil G. Bibby, 1951. ACID PRODUCTION IN DIFFERENT MOUTHS BY FIVE FOODS. Jour. dental Res., 30 (4): 495.

"Persistence of acid production from 5 foods (sprayed cracker, white bread, cookie, coconut candy, and toasted bread) were each tested in 11 student dental hygienists. The purpose of the study was to correlate the persistence of acid production in the oral cavity of various foods with the 'decalcification potential' of the food. Subjects brushed teeth, using tapwater, and stimulated saliva samples were taken before chewing and at 0, 5, 10, 20, 30, 60, and 120 minutes after chewing. pH and acid production readings were made immediately and after 4 hours incubation at 37.5° C. Results indicated that in incubated samples all of the foods increase the acid production for up to 30 minutes. Because individual variation within each patient group was too great, no correlation could be made with the 'decalcification potential' of the foods used." (Complete paper.)

Gol'dfel'd, A. I. A., and M. M. Pevzner, 1941. SLIUNOQOTDELITEL'NAIA FUNKTSIIA KAK POKAZATEL' SOSTOIANIIA ORGANIZMA U BOL'NYKH DIZENTERIEI [Salivary function as an index of body condition in cases of dysentery]. Arkh. biol. Nauk, Leningrad. 62 (3): 25-37.

Parotid saliva was studied in 68 dysentery patients receiving symptomatic treatment. Tests were made in some patients at 2 to 3-day intervals, and in others during the first and second phases of the disease and at discharge. Two successive 15-minute samples of saliva were collected from the capped parotid duct after 5-minute oral stimulation with 25 cc. of a 2% citric acid-sugar solution. Determinations were made of the lag periods, amount of secretion, percent of organic and inorganic content, dry residue, and amylase activity. Salivary determination in healthy subjects showed an average flow of 3.8 cc (range 3-5 cc.) of saliva in 30 minutes; organic matter averaged 0.303% (0.218-0.333%); ash, 0.237% (0.187-0.285%); dry residue, 0.54% (0.405-0.618%); and amylase activity, d 33°30'. 1435 units (1026-2048 units). Fourteen patients, with a very light infection and clinical recovery in 5-8 days, showed a 3 to 5-fold increase in salivation which returned to normal within a week after recovery. The lag period showed a slight increase. The amylolytic index increased 26 to 27 times the normal level prior to recovery. The dry residue showed a 41% increase on recovery then dropped to normal before again increasing during the week or two after recovery. A like increase in salivary organic matter paralleled the increase in dry residue. Salivation initially was subnormal to normal in a group of 26 moderately severe cases, showing recovery on the 5th to 26th day, then changed to a period of hypersecretion before returning to normal on recovery. Some increase was noted in the lag period, and a 13-fold increase in the amylolytic index prior to recovery. The dry residue and the organic content of the saliva showed a definite increase during the early part of the disease then doubled before return to normal on recovery. Severe cases particularly of the Shiga type evidenced greatly depressed or absent salivation for weeks; the lag period was prolonged where salivation was present, while the amylolytic index as well as the dry residue, and the organic and inorganic contents showed sharp fluctuations. Cases of chronic dysentery usually showed normal salivary flow or a 3 to 6-fold increase in salivation. Lag periods were normal during the first days of recurrence then showed an increase in length. The amylolytic index was normal during the first 5 days of moderate recurrence, then showed a 5-fold increase for a week before a return to normal in 2 to 3 weeks; severe attacks were characterized by a 4-fold decrease in the index. The salivary dry residue remained within the upper normal limit. The inorganic content was increased, especially in severe cases, where it exceeded the organic content.

Goldworthy, Neil E., and H. Florey, 1930. SOME PROPERTIES OF MUCUS, WITH SPECIAL REFERENCE TO ITS ANTIBACTERIAL FUNCTIONS. Brit. Jour. exper. Pathol., 11 (3): 192-208.

The antibacterial activity (inhibitory, bactericidal, lytic) of various body tissues and secretions in the cat, dog, rabbit, guinea pig, and goat was studied. Results of the salivary studies show that, with one exception, cat saliva was markedly bacteriolytic to *Bacillus faecalis*, *Escherichia coli*, and other test organisms. Lysozyme activity was noted in the saliva of the dog, rabbit, and guinea pig, the canine saliva being

markedly bacteriolytic. Goat saliva was totally lacking in such activity.

Goljanitzki, J. A., 1924. ZUR FRAGE DES ERSATZES DER ENDOKRINEN DRÜSEN (DIE INNERE SEKRETION DER SPEICHELDRÜSEN) [On the question of substitution for the endocrine glands (The internal secretion of the salivary glands)]. Arch. f. klin. Chir., 130: 763-779.

The significance of the salivary glands as endocrine glands was studied in 26 experiments on 22 rabbits.

(1) After unilateral ligatures of salivary ducts (6 tests), degenerative processes ensued in the salivary glands. On the ligated side, the parotid became edematous; general pathological changes are described. On the non-ligated side, considerable pathological changes occurred (i.e., unequal staining, necrotic foci, etc.). In both sides, the number of epithelial cells was noticeably decreased, while the interstitial cells became more prominent. None of the animals died, nor did they exhibit any external changes. (2) Resection of the salivary gland (2 bilateral tests and 3 unilateral ones) was characterized by the formation of scar-tissue and the development of cystic cavities. This scar formation may be so extensive that the actual gland tissue remains only in the form of isolated islands. After unilateral resection, the pathological changes on the "healthy side" were similar to those in the preceding study. No animals succumbed, but one rabbit (bilateral resection) was sacrificed after 23 days because of loss of weight. (3) When both the parotid and the submaxillary glands were isolated by ligature of all supplying tissues (4 tests), with one exception all animals succumbed within 4-7 days of loss of weight and cramps; the exception, one male rabbit, lived for 30 days. The cachexia in one animal was so pronounced that it had lost all its fur by the time of death after 7 days. In the isolated glands, there was either complete lymphoid transformation to the point where the glandular structure was obliterated, or extensive necrosis of neighboring tissues without lymphoid infiltration. In several animals, the sugar in the urine either increased or decreased. (4) After salivary gland transplantations (three in the neck region and one in the abdominal cavity), all animals save one succumbed at various times. In the exception, the parotid gland had been transplanted into the abdominal cavity and remained in relatively good condition for 21 days, at which time all four salivary glands were extirpated. The animal survived 18 days thereafter without a reduction in weight, and was then sacrificed. (5) Bilateral extirpation of all four glands (parotid and submaxillary) in 5 tests was fatal to all animals within 5-11 days. No organic changes were observed. When gland fragments remained, death was delayed. Sugar occurred in the urine of one animal from the first day on. (6) Unilateral isolation of the gland (3 tests) led to similar changes as in Test (1). The growth of the treated rabbits was studied in comparison with the controls; however, the animals were not emaciated nor did they lose their alertness.

It is concluded that the salivary glands have both secretory and endocrine functions; in the "substitution" experiments, large cells assumed the function of the salivary glands; the internal

secretion of the salivary glands influences nutrition, sugar retention, and growth. In "complete substitution" experiments (ligature, isolation, and transplantation), the pathological changes occurring in the intact gland are attributed to the production of cytotoxins.

Goncharov, P. P., 1948. OB IZMENENII FUNKTSII SLIUNNYKH ZHELEZ PRI REFLEKSAKH S KISHECHNIKA [Concerning the change in function of the salivary glands under the influence of intestinal reflexes]. Fiziol. Zhur. SSSR, 34 (1): 33-40.

Intestinal fistulae were made in four dogs whose salivary ducts had been surgically exposed. In the first series of experiments the influence of visceral reflexes on salivation produced by food stimuli was studied. The dogs were fed meat or rusks in powder (swallowed in 30-40 sec.) and the saliva collected in 1.5 minutes after start of the feeding. After the normal standard of salivation had been established, the same stimulant was given while inflating the bowels through the fistulae. In some cases the inflating preceded the feeding 1 to 15 sec., in others it was done simultaneously. The collected saliva was examined as to content of water, organic substances and ash. Results of experiments showed that the intestinal reflex sharply depresses the secretory function of the salivary glands in all dogs, regardless of their type, the nature of the food, or the part of the intestine inflated. Depression was most marked after the inflation of the appendix or when the inflation preceded the feeding by 15 seconds. In some cases the inflation conducted during the feeding produced a 30-40% reduction in salivation, while the inflation preceding the feeding caused a depression double or more of this amount in the salivary flow. Simultaneously, increase of the dry residue of saliva, in particular of the organic matter, was observed. Increase of mineral substances was noticed in 10% of the cases only, in 60% a noticeable decrease was observed.

In the second series of more than 50 experiments the influence of visceral reflexes on conditioned salivation was studied. Two stimuli: the conditioned, and the unconditioned (feeding) were applied at the same time to two dogs. After the conditioned reflex, obtained through the tapping of a metronome, had become sufficiently consolidated, salivation was studied in the presence of both stimuli as well as with the conditioned reflex plus intestinal inflation. The results obtained showed that the conditioned salivation is greatly depressed by addition of intestinal stimulation; as much as 1-2 drops of saliva could be obtained only in isolated cases, in all the others there was no secretion at all. The author believes that such a depression of the secretion produced by conditioned stimulation is possible only through the action of the cortical substance of the brain. The author considers these experiments to prove that the unconditioned reflexes of the intestine are more powerful and block the conditioned nervous connections; the impulses from both the small and large intestine arrive at the cortical substance of the brain and produce important changes in the nervous activity.

The inflation of the intestine during active salivation produced by subcutaneous injection of 4-5 ml. of a 1:1000 solution of pilocarpine does not give such a considerable reduction in secretion.

The author suggests that nerve fibers to the parotid gland inhibit, while other fibers augment the stimulation, as was found to be the case for the submaxillary glands.

Gonka, . . . , 1900. O VYDELENII I SOSTAVE SLIUNY OKOLOUSHNOI ZHELEZY [Secretion rate and composition of parotid saliva]. *Przeglad lekarski*, 1900 (27-28), [unpaginated]. *Bol'nich. Gazeta Botkina*, 11 (35): 1670-1681.

Parotid secretion was studied in 10 tracheotomized dogs under conditions of mechanical and chemical stimulation of nasal and oral mucosa, faradic stimulation, injection of various stimulants, and hypoxia. Parotid secretion was found to differ from submaxillary. Curare and other stimulants, which increased submaxillary salivation, had little effect on parotid flow. Unilateral stimulation of the peripheral nerves of the oral cavity increased ipsilateral submaxillary flow but had variable effects on parotid salivation. Parotid saliva was found to contain more organic matter than submaxillary, 0.75% to 3.0%.

Goodman, Edward H., 1909. RECENT ADVANCES IN THE PHYSIOLOGY OF SALIVA, TOGETHER WITH CERTAIN ASPECTS OF ITS PATHOLOGY. *Proc. path. Soc. Philadelphia*, 29 (2): 142-158.

A general review of literature data on the physiology of saliva is presented. 24 refs.

Gorbunova-Nikoleava, M. M., and E. N. Speranskaya-Stepanova, 1935. ANTAGONISTICHESKOE DEISTVIE ADRENALINA I KALTSIIA PO OTNOSHENIIU K $MgSO_4$ [The antagonistic action of adrenalin and calcium in regard to $MgSO_4$]. *Fiziol. Zhur. SSSR*, 18 (6): 1031-1033.

No salivation was elicited by chordal stimulation or intravenous injection of pilocarpine in dogs during magnesium narcosis induced in prolonged experiments. Further tests were conducted to study the effect in 7 dogs anesthetized by a variety of drugs; the influence of the central nervous system was eliminated. Intravenous injection of 0.1 to 2.0 gm./kg. of 10 to 25% solutions of $MgSO_4$ produced a marked inhibition up to complete cessation of chordal salivation, dependent upon the dose administered. Subsequent intravenous injection of 10 cc. of 10% $CaCl_2$ reactivated chordal salivation at the original rate without affecting narcosis, while similar injection of 2 cc. of 1:25000 adrenalin or neural sympathetic stimulation produced a temporary reactivation of chordal salivation. Neural, vascular, and glandular effects of adrenalin and $CaCl_2$ during $MgSO_4$ narcosis are discussed.

Gore, J. T., 1935. SALIVA AND ENAMEL DECALCIFICATION. *Dental Cosmos*, 77 (10): 942-950.

Description is given of a variety of tests on saliva which indicates salivary mucin to be a glycoprotein. The amount of carbohydrate was found to vary from 14 to 55 mg./100 cc. of paraffin-stimulated saliva. Variation in buffering power of saliva was also noted, with 0.2 to 2.5 cc. of a 0.1% lactic acid solution required to produce an acid litmus reaction in 2.5 cc. of fresh saliva. Physical changes in saliva observed on exposure of fresh saliva at 37°, 40°-45° and 75°C are shown to be due to the hydrolytic activity of ptyalin on the carbohydrate component of mucin, producing a reducing sugar which is fermented by

bacteria to an acid. The addition of small amounts of lactic acid to saliva warmed to 37°C was found to increase the viscosity of the saliva and to hasten mucin precipitation. In further tests fresh saliva was permitted to settle for 1 hour at room temperature.

Sound, extracted teeth were incubated at 37°C in the alkaline salt-containing supernatant salivary fluid, and in the mucin-containing precipitate. Both salivary fractions were renewed daily during the three-month experiment. The supernatant fluid portion was found to remain alkaline and produced no change in the immersed tooth. The precipitate portion invariably became acid and the immersed tooth showed marked decalcification. It is suggested that physical changes which occur in saliva after secretion from the glands may prevent buffer action by the alkaline salts and permit localized acid formation and dental decalcification.

Gore, J. T., 1938. SALIVA AND ENAMEL DECALCIFICATION. II. SALIVA SEPARATOR. *Jour. dental Res.*, 17 (1): 69-74.

The construction of a "saliva separator", a device permitting the separate collection of parotid saliva and mandibular saliva, is described in detail. The appliance facilitates both the determination of the amount of saliva secreted under various conditions (stimulation, diet, etc.) and the determination of physical and chemical properties of each of the two sets of secretions.

When employed by the author (on himself), the quantitative difference between the two unstimulated salivas (secreted the same day between meals on a balanced diet) was negligible; the parotid saliva secreted was 20 cc./hr., the mandibular, 19 cc./hr. After paraffin-stimulation the amounts increased greatly; the parotid saliva to 120 cc. per hour, the mandibular, to 36.4 cc./hr. At night, the salivary flow decreased, more markedly in the parotid.

The effect of diet was studied; a notable increase in mandibular saliva occurred on a high-carbohydrate diet.

Gore, J. T., 1938a. SALIVA AND ENAMEL DECALCIFICATION. III. AUTOLYSIS. *Jour. dent. Res.*, 17 (5): 411-421.

A report is made of changes in the carbohydrate content of saliva (mg. glucose/100 cc. saliva) of the author while on a low carbohydrate and on a high carbohydrate diet. A steady decline was noted in the carbohydrate content of whole, unstimulated saliva until a minimum was reached on the fourth day of the low carbohydrate diet. Further tests were made of salivary quantity, carbohydrate content, diastatic activity, and alkaline reserve of both parotid and mandibular salivas at 2-hour intervals over a 24-hour period while continuing on the low carbohydrate diet. Comparison of results with those obtained while on a high carbohydrate diet showed the carbohydrate content of unstimulated mandibular saliva during high carbohydrate intake to average twice that of like saliva during low carbohydrate intake; similar changes in parotid saliva were insignificant. Whole unstimulated saliva during high carbohydrate intake averaged 55 mg. of glucose, and during low intake, about 30 mg. After one hour of precipitation at room temperature 60% of this sugar is found in the mucin precipitate.

Diastatic activity tests at 2-hour intervals over a 24-hour period on fresh, unstimulated parotid and mandibular salivas while on the high and low carbohydrate diets showed parotid saliva to be more active than mandibular. Both salivas were more active during high carbohydrate intake; both showed rapid and variable changes with a general decrease of activity in early-morning hours. Similar determinations of whole unstimulated saliva while on the contrasting diets showed the increased diastatic activity and increased carbohydrate of the saliva while on the high carbohydrate regime.

Salivary samples, collected while on a high carbohydrate diet and either kept at 7°C for 48 hours or at 37°C for 4 hours after addition of thymol to prevent fermentation, show the presence of reducing sugar. Salivary ptyalin is thus considered to hydrolyze the complex carbohydrate molecule, effecting autolysis of the mucin in the stagnant saliva.

Gore, J. T., 1939. SALIVA AND ENAMEL DECALCIFICATION. IV. ALKALINE RESERVE. Jour. dental Res., 18 (3): 268.

"Microscopically, unlike clinically, there are only 2 types of enamel decalcification; one in which the enamel surface remains intact but a macroscopic lesion may appear, produced in presence of adequate H, Ca and PO_4 ions in the saliva, the other in which there is a loss of surface continuity with adequate H ion but inadequate Ca and PO_4 ion concentration in the saliva. These 2 types of decalcification were produced in teeth in vitro by variations in the dextrose and $Ca_3(PO_4)_2$ content of saliva. Following the first type of decalcification the process of remineralization is explained as a deposition of solid $Ca_3(PO_4)_2$ at the point of dissolution of $CaCO_3$, both due to decrease in H ion concentration at that point. It is suggested that the confusion in dental literature regarding the interpretation of results from different methods of investigation is probably the result of changes in salivary composition in vivo, producing mixed types of decalcification." (Complete paper.)

Gore, J. T., 1940a. SALIVA AND ENAMEL DECALCIFICATION. IV. FACTORS INVOLVED IN THE PREVENTION OF CARRIES. Jour. dent. R. S., 19 (5): 455-471.

The alkaline reserve of fresh, unstimulated parotid and mandibular salivas of the author were determined at 2-hour intervals for a 24-hour period, by titration with a 0.1 percent lactic acid solution using a litmus indicator. Samples were obtained while on a low carbohydrate and then on a high carbohydrate diet. Results are tabulated: a definite decrease in the alkaline reserve of the mandibular saliva on the high carbohydrate diet is noted.

Decalcification tests were conducted on 50 extracted teeth, having an exposed enamel area of 100-150 sq. mm., while incubated at 37°C in 25 cc.-samples of whole stimulated saliva mixed with 250 mg. of dextrose and 1 gm. of $Ca_3(PO_4)_2$. The teeth were placed in the mixture, 5 to 6 hours after start of incubation, when fermentation was well established. The incubation mixture was replaced after 48-72 hours of incubation when the dextrose present had been fermented. The time required to ferment the dextrose was

inversely proportional to the area of dental enamel exposed.

Graphed results show that, in the presence of such Ca and PO_4 ion concentrations, the pH of the mixture drops steadily during the first 10 hours of incubation and then gradually to about pH 4.4; $CaCO_3$ is removed from the intercolumnar substance with gas being evolved from the action of the acid on the enamel. In tests of decalcification in incubated mixtures lacking the $Ca_3(PO_4)_2$, 10 cc. of saliva was mixed with 100 mg. of dextrose and approximately 6 sq. mm. of enamel surface exposed. A rapid drop in pH of this mixture was noted during the first 4 hours of incubation followed by a gradual drop to pH 4.07. Examination of the tooth showed both intercolumnar substance and enamel rods to be dissolved away. It is concluded that the concentration of Ca and of PO_4 ions in the saliva determines the type of enamel decalcification.

Gore, J. T., 1940. SALIVA AND ENAMEL DECALCIFICATION. V. CLINICAL INTERPRETATION. Jour. dental Res., 19 (6): 563-570.

"The various clinical forms of enamel decalcification, including pit and fissure, approximal, gingival, mechanical abrasion (brush or attrition), erosion, cracks, increasing friability, penetrating stains and senile caries are probably the result of the chemical composition of the saliva and the chemical and physical changes which take place in the stagnant saliva." (Author's summary.)

Gore, J. T., 1941. SALIVA AND ENAMEL DECALCIFICATION. VI. PREDISPOSING CARRIES FACTORS. Jour. dent. Res., 20 (2): 107-115. [Abstract: *ibid*, 20 (3): 275].

Iodine tests of human mandibular saliva showed the presence of either erythrodextrine or of glycogen. Diastatic tests with glycogen were made of mandibular and parotid salivas of persons on high and on low carbohydrate diets. Incubation at 37°C of mandibular and parotid salivas, collected at various times of the day, with standardized solutions of glycogen showed glycogenase present in both salivas; glycolysis was much more active in parotid saliva than in mandibular saliva, and in the salivas of persons on a high carbohydrate diet. The minimum pH attained by incubation of the author's saliva was 3.76; diastatic tests of this saliva showed the glycogenase to be active at pH. 3.70. While numerous tests made to isolate glycogen from the saliva were unsuccessful, indirect evidence of glycogen was found in mandibular saliva boiled several hours in 30% KOH to destroy all proteins and reducing sugars. An iodine test of such saliva, after slight acidification, showed the presence of reducing sugar. It is suggested that failure to isolate glycogen in the saliva may be due to partial hydrolysis of glycogen in the tubules and ducts of the salivary glands before entry of the saliva into the mouth. A discussion is given of the carbohydrate content of saliva, and the secretion of insulin in saliva, in relation to dental caries.

Gore, J. T., 1942. POTENTIAL ACIDITY AND IMPERMEABILITY OF SPONTANEOUSLY PRECIPITATED SALIVARY MUCIN. Jour. dental Res., 21 (4): 383-385.

The formation of acid by hydrolysis and fermentation of the carbohydrates in mucin was studied in human saliva.

The author collected 50 cc. of his own paraffin-stimulated saliva in a flask containing 2 mg. bromocresol purple. 25 cc. of the mixture were placed in a 50 cc. centrifuge tube which had thymol crystals fused to its sides (to prevent fermentation of the salivary carbohydrate, and to destroy the acidogenic bacteria without destroying the enzymes). The remaining 25 cc. of the bromocresol purple saliva mixture were placed in a second tube, without thymol, and the two tubes were then incubated.

The supernatants of both tubes and the precipitate in the first tube remained purple throughout the experiment. In the second tube (in the absence of thymol), the precipitate was lighter, tending toward a yellow-gray color, which became more yellow with standing, the pH of the precipitate being approximately 5.4 after 8 hours; the supernatant liquid, however, remained near the neutral point.

When H-ion determinations were made with a glass electrode in a duplicate experiment without the use of thymol, the pH of the supernatant liquid was found to be 7.02 and that of the precipitate, 6.42. (The pH of the whole fresh saliva had been 7.20).

The author interprets the results of the experiment as follows: The enzymes in the tube with thymol had remained active, but the acidogenic bacteria had been destroyed and no acid was formed. In the second tube (containing no thymol crystals) acid was formed when hydrolysis and fermentation occurred. No reducing sugar was present when tested with Benedict's copper solution. The degree of acidity attained in the mucin precipitate depended upon the concentration of the carbohydrate.

Gore, J. T., 1943. INDIVIDUAL SUSCEPTIBILITY TO DENTAL CARIES. *Jour. Amer. dental Assoc.*, 30 (13): 1018-1029.

Individual variations in susceptibility to dental caries are attributed to variations in diet and to nocturnal salivary currents which "localize" the acid formed by hydrolysis and fermentation of mucin to certain areas of enamel known to be particularly susceptible to decalcification.

Gore, J. T., 1956. FACTORS INFLUENCING THE PHYSICAL AND CHEMICAL PROPERTIES OF SALIVA. *Jour. Dental Res.*, 35 (1): 102-108.

Determinations were made of the carbohydrate concentration (as glucose) of the author's saliva at different periods of the day and night while on a uniform high or low carbohydrate diet. Results indicated that a single high carbohydrate meal could cause a temporary increase in the carbohydrate concentration of whole unstimulated saliva. Measurements of the rate of flow of whole unstimulated saliva and its carbohydrate concentration over a 24 hour period (on the restricted diet) showed the flow rate to drop during the nocturnal hours while the concentration rose. Separate measurement of the parotid and the mandibular (submaxillary, sublingual, and mucous glands) salivas showed the greatest decrease in salivation occurred in parotid saliva, increasing the ratio of the rate of secretion of the mandibular to parotid saliva. The carbohydrate concentration of parotid saliva remained low and fairly constant, whereas the concentration in mandibular saliva rose during the night.

Determination of the diurnal carbohydrate concentration of whole stimulated and unstimulated saliva showed the unstimulated saliva to have a concentration of 27 mg./100; stimulated saliva collected immediately after the unstimulated saliva had a concentration of 12.5 mg./100. Cleaning of the mouth prior to salivary collection, and the method of collection are considered to affect the chemical and physical properties of the saliva. Smoking, talking, the movement of tongue, lips, and cheeks, and physical activity were found to increase the rate of salivary secretion and thus change the carbohydrate concentration of whole saliva.

Gorlin, Robert J., 1948. VARIATIONS IN SALIVARY PROTEIN CONCENTRATION. *Jour. dent. Res.*, 27 (5): 603-608.

"In the course of investigation of salivary protein by the Tiselius electrophoretic apparatus, the author observed variation in both pattern and mobility of the several components. The variation led to this study of salivary protein to determine whether a constant amount of protein could be obtained by uniformity in collection technic. This was undertaken because the work of Krasnow and Karshan and Tennenbaum and Deakins had demonstrated wide variations in salivary protein values. Mean values in several studies have established salivary protein concentration to be 260 to 300 mg./100 cc. of saliva. However, the standard deviations in these studies have varied from 45 to 118, demonstrating the wide range of values. In this study, several variables were made constant, that is, salivary samples were uniform as to amount collected (5 c.c.), time of salivary stimulation (2 minutes), size of paraffin block (1 x 1 x 1/2 cm.), and collection-analysis interval (1/2 to 1 hour). Samples were taken from 35 volunteers who had had no breakfast, for purpose of minimizing the effect of protein intake. The effect of smoking and water intake upon salivary protein concentration was not determined in this study. The method of Greenberg, as adapted for salivary protein by Krasnow, was utilized on 1 c.c. samples. A mean value of 280.37 mg./100 cc. saliva was obtained. The standard deviation was 65.93 and the standard deviation of the mean was 11.31. It may be concluded from this study that control of the above mentioned factors has no effect upon the variation of salivary protein concentration." (Author's abstract)

Gorlin, Robert J., 1948a. VARIATION IN SALIVARY PROTEIN CONCENTRATION. *Jour. dent. Res.*, 27 (6): 713; 759.

Identical abstracts of Gorlin, 1948.

Graber, T. M., 1947. LOCAL FACTORS IN DENTAL CARIES; A CRITICAL REVIEW OF THE LITERATURE. *Jour. Amer. dental Assoc.*, 35 (2): 92-111.

An extensive review of the literature on dental caries, including a discussion of bacterial plaques, nature of oral bacteria, chemical constituents of saliva, rate of secretion, etc. 179 refs.

Grad, B., 1952. THE INFLUENCE OF ACTH ON THE SODIUM AND POTASSIUM CONCENTRATION OF HUMAN SALIVA. *Jour. clin. Endocrinol. Metabol.*, 12 (6): 708-718.

"Determinations of the Na and K concentrations in specimens of unstimulated saliva collected from 4 patients before meals and at bedtime for several days, before, during, and after ACTH [adrenocorticotrophic hormone] revealed the following:

"a) ACTH significantly reduced the Na/K ratio in 15 out of 16 experiments, this effect being similar in specimens collected at different times of the day.

"b) Whether or not ACTH was administered, the Na/K ratio was higher before breakfast than at other times of the day, suggesting a lower output of endogenous ACTH before breakfast than during the day.

"c) The response of the Na and K concentration of saliva to ACTH was similar to and as sensitive as that of sweat, or as that of the daily amounts of Na and K in the urine.

"d) The day-to-day variation in the Na and especially in the K concentration of unstimulated saliva collected at the same time of day was relatively slight, even though the subjects were on an unrestricted intake of Na and K.

"e) The studies presented on saliva are technically simpler than comparable studies on urine or sweat." (Author's summary.)

Graham, L. W., 1919. LITMUS AS AN INDICATOR OF THE SALIVARY REACTION. *Dental Cosmos*, 61 (5): 409-412.

Two cc. of paraffin-stimulated saliva were dialyzed for 5 minutes at room temperature against 0.8% NaCl solution before noting the litmus reaction of the sample. The color obtained by addition of 0.2 cc. of phenolsulfonaphthalein to the sample was matched against tubes of known H ion concentration to determine the pH of the saliva. The experiments showed that while the pH of saliva can vary considerably in an individual, most alkaline reactions are above pH 6.8. A few are noted between 6.6 and 6.7. Below pH 6.6 the saliva reacts acid to litmus, although in a few instances the litmus reaction is neutral. Neutral reactions of litmus do not coincide with a constant pH and are not considered as accurate indicators of neutral saliva. It seems probable that pH 6.6 and 6.7 are the limits of the neutrality of litmus indicating that litmus is much more delicate as an indicator than has been supposed. Litmus is thus reliable for detecting hyperacidity and hyperalkalinity of saliva. The phenolsulfonaphthalein test can be used for more exact pH determination.

Granados, Humberto, Johs. Glavind, and Henrik Dam, 1950. OBSERVATION ON EXPERIMENTAL DENTAL CARIES. XIII. THE EFFECT OF ADDING TO THE DRINKING WATER SALIVA FROM TWO SUBJECTS WITH DIFFERENT CARIES-SUSCEPTIBILITY. *Acta pathol. et microbiol. scandinav.*, 27 (1): 65-68.

Thirty-six weanling hamsters, reared from weaning on the same cariogenic diet, were litter-mate distributed into three groups (6 males and 6 females each). The diet contained 1% salt, 2% alfalfa meal, 5% brewer's yeast, 2% powdered whole milk, 25% finely ground yellow corn, and 45% sucrose. The diets were supplemented for 100 days by the following fluids: Group I, 40 cc. distilled water and 20 cc. unstimulated saliva from a caries-active female; Group II, 40 cc. distilled water and 20 cc. unstimulated saliva

from a caries-resistant male; and Group III, 60 cc. distilled water only. Animals receiving saliva from the caries-resistant person (Group I) had fewer cavities than the two remaining groups. The increase in weight of the animals receiving saliva in drinking water (Groups I and II) was indicative of the presence of a growth factor in saliva.

Granados, Humberto, Johs. Glavind, Bent Noer, and Henrik Dam, 1950a. STUDIES ON THE GROWTH-PROMOTING ACTION OF HUMAN SALIVA. *Acta pathol. et microbiol. scandinav.*, 27 (4): 501-505.

Twenty-seven golden hamsters, litter-mate distributed in 3 groups of 9 animals each (5 males and 4 females) were maintained on a diet containing all the chemically identified vitamins for 12 weeks (Table I); the drinking fluids varied among the groups. Group I received distilled water alone; Group II, distilled water and equal amounts of saliva from healthy male individuals between 31 and 37 years of age; and Group III received equal amounts of distilled water and saliva from healthy females 18 to 24 year old.

Weekly weighings showed that human saliva contains factors different from the chemically known vitamins and from vitamin B₁₂, which consistently and considerably increase the growth of hamsters.

Microbiological examinations showed that the concentration of vitamin B₁₂ in human saliva was from 0.00015 to 0.0005 micrograms per ml. saliva.

Green, Gordon E., and M. C. Dodd, 1953. MICROORGANISMS FROM SALIVA OF CARIES-FREE AND CARIES-SUSCEPTIBLE HUMAN BEINGS. *Jour. dent. Res.*, 32 (5): 651.

A study of the salivary flora of 25 caries-free and 25 caries-susceptible individuals indicated the major difference to be in the number and kind of lactobacilli present. Caries-free individuals had average counts of 2,000 per cc., all of which were the smooth type lactobacilli; caries-susceptible individuals had average counts of 400,000 per cc. and 55 percent of these were of the rough type. The strains of lactobacilli were studied culturally and biochemically. Smooth strains from both caries-free and caries-susceptible individuals appeared to be indistinguishable, while rough strains from caries-susceptible individuals were entirely different.

Green, Gordon E., and H. S. Inverso, 1955. INHIBITION OF ORAL LACTOBACILLI BY STREPTOCOCCI. *Jour. Dental Res.*, 34 (5): 691-692.

In vitro studies were made of the inhibition of oral lactobacilli by freshly isolated strains of salivary streptococci, principally *Streptococcus mitis* and *Str. salivarius*. Eighty-six strains of mucoid and non-mucoid streptococci were tested against 10 strains of salivary lactobacilli from 24-hour brain-heart infusion broth cultures. The lactobacilli were seeded into brain-heart infusion agar plates with one drop of a test streptococcal culture being placed in one quadrant of the plate. No inhibition differences were found between streptococci isolated from caries-immune or caries-susceptible subjects. Intermediate colony types of lactobacilli were found more resistant to inhibition than smooth or rough types. Growth of lactobacilli was inhibited by 61% of non-mucoid, *Str. mitis* strains

and by 47% of mucoid, *Str. salivarius* strains. Acid production of lactobacilli was inhibited by 55% of *Str. mitis* strains, 11% of *Str. salivarius* strains. Quantitative examination of the salivas of caries-immunes and caries-susceptibles for these streptococcal strains showed that predominance of the mucoid or non-mucoid types was not related to the numbers of possible inhibitory organisms present in the saliva. (From author's abstract)

Green, Gordon E., and M. C. Dodd, 1956. A STUDY OF THE BACTERIAL FLORA OF CARIES SUSCEPTIBLE AND CARIES-IMMUNE SALIVA. *Jour. Dental Res.*, 35 (4): 572-585.

A comparative study was made of the salivary flora of 25 subjects each from two groups of caries-immune and caries-susceptible individuals. Paraffin-stimulated salivary samples were obtained at least an hour after a meal, the donors having refrained from smoking or chewing gum for 10 minutes prior to collection of the samples. No significant quantitative differences were found in gram-negative diplococci, gram-negative rods, caseolytics, yeasts, acidogenic streptococci, or micrococci. There were significantly fewer lactobacilli in the salivas of the caries-immune subjects; aciduric streptococci were identified (tomato juice agar, pH 5) from nearly all samples of immune saliva and from fewer samples of susceptible saliva. Smooth colony-type of growth of lactobacilli was almost exclusively associated with immune saliva, while 55% of colonies developing from susceptible salivas were of the rough type. Studies of lactobacillus strains on laboratory media showed dissociation of colony type, (smooth, intermediate, rough) to be influenced by the composition, pH, and physical state of the media.

In tests of the inhibitory capacity of immune and susceptible salivas to growth of lactobacilli, freshly isolated cultures of lactobacilli were inoculated into tubes of saliva, saliva-glucose, and saliva-tomato juice broth. Turbidity determinations of growth showed a period of increased light transmission, or inhibition, to occur in the immune saliva-tomato broth with 9 of 10 lactobacilli cultures during the first 6 hours after inoculation. Five cultures each, grown for 16 hours in immune saliva-tomato broth and in susceptible saliva-tomato broth, were inoculated into fresh tubes of the same substrates; no evidence of subsequent inhibition was seen. Inhibition was also lacking in immune saliva-tomato broth in which cultures had grown 16 hours, prior to sterilization and reinoculation from broth cultures of the same organisms.

Studies of salivary effect on growth and acid production of lactobacilli were also made, using sterile filtrates from pooled salivas of caries-immune and of caries-susceptible subjects. Both salivas were found to inhibit acid production, the caries-immune saliva to a greater extent. Both salivas induced changes in colony morphology; passage to immune saliva induced variation to a non-aciduric form, sensitive to acid concentration around pH 5, which was less acidogenic on tomato juice agar than the original parent cultures. A relationship appeared to exist between the inhibition, noted in broth cultures during the first 6 hours of incubation, and the appearance on inoculated plates of non-aciduric

variants which became predominant in 6 to 24 hours. The immune saliva appears to exert a selective effect related to the process of inhibition in order of occurrence.

Green, G. E., P. R. Weisenstein, and D. Permar, 1957. STUDIES ON SALIVARY LACTOBACILLI AND DENTAL CARIES IN CHILDREN DURING A DENTRIFRICE TEST PROGRAM. *Jour. dent. Res.*, 36 (6): 828-838.

A dentrifrice containing a dichlorophenyl methane compound was tested, with a control dentifrice, for effect on dental caries increment and salivary lactobacilli in a group of school children. By comparison with the control, the experimental dentifrice had no effect on caries increment, on total number of salivary lactobacilli, on numbers of different colony types of salivary lactobacilli, nor on the ability of salivary lactobacilli to ferment sucrose in vitro. The study group of 394 Ohio children, aged 6 to 14 years, were examined for number and kind of salivary lactobacilli and for dental condition (DMFS) at the beginning and 339 of the children, at the end of a 1-year period. At both examinations, salivary lactobacilli counts of less than 10,000 per ml. were more common than higher counts in this group of children. Lactobacilli of smooth colony morphology were observed more frequently than those of intermediate or rough morphology in the saliva samples examined. In individuals, total salivary lactobacilli counts at the first examination showed no apparent association with past caries history (DMFS scores) determined at that time. Total restoration of carious lesions was found to be associated with lower salivary lactobacilli counts and lower subsequent caries incidence than was found in subjects who had only partial or no restorations of carious lesions. In each child, the average of 3 salivary lactobacilli counts made at the first examination was compared to the dental caries increment during the following year. The data showed a relationship between magnitude of salivary lactobacilli counts and future dental caries, which was, however, apparent only in grouped data, and was not clearly expressed in individuals. The results indicated that 3 closely-spaced salivary lactobacilli counts could not be used for successful prognosis of future dental caries on an individual bases in this group of children. A number of children in this study were found to have caries-free permanent dentition at the first examination. Neither salivary lactobacilli nor the history of caries in deciduous teeth could be associated with either caries attack or continued caries freedom in these children during the study year. (Authors' summary)

Green, G. E., 1958. INFLUENCE OF CARIES ACTIVITY ON RESPIRATION OF SALIVARY MICROBIAL FLORA. *Jour. dent. Res.*, 37 (1): 43.

Findings are reported concerning the endogenous respiration and oxidation of glucose, lactate, acetate, and pyruvate by the salivary microbial flora of 25 caries-active and 25 caries-inactive subjects. Data are statistically correlated to dental caries activity. (From author's abstract)

Green, G. E., M. C. Dodd, and A. W. Radike, 1958a. RELATIONSHIP OF SALIVARY TRYPTOPHANE TO LACTOBACILLUS COLONY MORPHOLOGY AND DENTAL

CARIES. Proc. Soc. exper. Biol. Med., 90 (2): 517-520.

In a study of tryptophane-induced rough to smooth dissociation in colony morphology of oral lactobacilli, determinations were made of the salivary tryptophane and indol content of 31 young adult caries-immune and caries-susceptible subjects. Glyoxilic acid tests showed significantly greater amounts of tryptophane and indol in immune salivas. Although smooth colony salivary lactobacilli were associated with high salivary tryptophane, intensive chewing of paraffin, containing dl-tryptophane, during 6 hours daily for one week by caries-susceptible dental students, increased the salivary tryptophane content but did not affect their salivary counts of smooth and rough colony types of lactobacilli. Results of the addition of dl-tryptophane or indol to culture media are described and discussed in detail.

Green, S., 1954. BIOLOGICAL DEMONSTRATION OF ESTROGENIC SUBSTANCES EXCRETED IN HUMAN SALIVA. Proc. Soc. exper. Biol. Med., 86 (4): 653-655.

Estrogen assay of paraffin-stimulated saliva samples from 2 patients, collected after intravenous infusion of 1000 mg. of stilbestrol potassium sulfate, showed the presence of the estrogenic substance in their salivas. Preliminary work with saliva of other patients receiving large amounts of testosterone suggests that androgens may also be excreted in the saliva.

Greenbaum, Sigmund S., and Henry Tumen, 1936. SEVERE XEROSTOMIA FROM X-RAY TREATMENT FOR HYPERTRICHOSIS. Jour. Amer. med. Assoc., 107 (16): 1297.

Report of a case of severe xerostomia in a 52-year-old woman following 24 X-ray treatments of both sides of her face for excessive hair by a "cosmetologist". Discontinuation of the treatments was followed by improvement of the condition within the following year although xerostomia was still present to a moderate degree.

Gregersen, Magnus I., and Elizabeth N. Ingalls, 1931. THE INFLUENCE OF RATE OF SECRETION ON THE CONCENTRATIONS OF POTASSIUM AND SODIUM IN DOG'S SUBMAXILLARY SALIVA. Amer. Jour. Physiol., 98 (3): 441-446.

Experiments on submaxillary saliva of 4 dogs, 2 pilocarpine- and two chorda-stimulated, show that the sodium concentration of submaxillary saliva varies between 10-90 cc. of 0.1N per 100 cc. of saliva and is closely dependent on the secretion rate. The potassium concentration, however, remains practically constant, varying between 10-20 cc. of 0.1N per 100 cc. of saliva.

Gregersen, Magnus I., 1931a. A METHOD FOR UNIFORM STIMULATION OF THE SALIVARY GLANDS IN THE UNANESTHETIZED DOG BY EXPOSURE TO A WARM ENVIRONMENT, WITH SOME OBSERVATIONS ON THE QUANTITATIVE CHANGES IN SALIVARY FLOW DURING DEHYDRATION. Amer. Jour. Physiol., 97 (1): 107-116.

"Uniform stimulation of the salivary glands in the unanesthetized dog may be obtained by exposing the animal to a warm atmosphere of constant temperature, thereby producing always the same rate of panting (polypnea). As panting dries the mouth and tongue, the salivary glands

are reflexly stimulated to secrete a thin, watery saliva which may appropriately be called the 'polypnea secretion'.

"Holding the dog's mouth closed or spraying the mouth with water promptly lessens the polypnea secretion.

"In a warm room with a temperature of 40°C. the polypnea secretion reaches a definite level within 10 to 15 minutes and has been observed to stay constant for over two hours.

"On a normal water intake the polypnea secretion remains nearly the same from day to day..., but after 24 hours without water it is often reduced to one-half the normal rate, and after 3 days' water deprivation it may fall to one-fifth the normal....

"This method of uniform stimulation of the salivary glands is being used in an attempt to uncover the physiological mechanism responsible for the reduction in salivary flow that accompanies dehydration." (Author's summary.)

Gregerson, Magnus, 1932. THE PHYSIOLOGICAL MECHANISM OF THIRST. Amer. Jour. Physiol., 101 (1): 44-45.

Extirpation of the salivary glands resulted in an increase in the water intake of 2 dogs during 1 or 2 hours of panting. A deficient salivary flow may thus cause thirst and increased water intake in the absence of bodily dehydration. A study of the drinking of dogs showed that deprivation of water during or after a meal caused a 20 to 30% drop in plasma volume which may return to normal without further intake of water. Similar changes occur in the salivary flow. A 2-day period of water deprivation produced a drop in salivary flow and plasma volume equivalent to that of a normal meal which temporarily withdraws fluid from the gland in the form of digestive juices. It is suggested that the dry mouth in dehydration arises from circulatory adjustments following a decrease in plasma volume.

Gregersen, Magnus I., and Walter B. Cannon, 1932a. STUDIES ON THE REGULATION OF WATER INTAKE. I. THE EFFECT OF EXTIRPATION OF THE SALIVARY GLANDS ON THE WATER INTAKE OF DOGS WHILE PANTING. Amer. Jour. Physiol., 102 (2): 336-343.

The amount of water taken by dogs during 1 or 2 hours of panting is increased after extirpation of the submaxillary, sublingual and infra-orbital glands and tying the parotid ducts. Therefore, under conditions which make the mouth dry, a deficient salivary flow causes thirst and increased water intake even in the absence of bodily dehydration [cf. table 1, p. 339; figs. 1 and 2, p. 340 and 341]. (Authors' summary and conclusions.)

Gregersen, Magnus I., and Lewis T. Bullock, 1933. OBSERVATIONS ON THIRST IN MAN IN RELATION TO CHANGES IN SALIVARY FLOW AND PLASMA VOLUME. Amer. Jour. Physiol., 105 (1): 39-40.

Changes in salivary flow in relation to changes in plasma volume were measured in 2 normal male subjects during a period of 2 and 3 days without water. Salivary flow, during a 5 minute period of mouth breathing by the subject without water for 2 days, dropped from a normal 5 cc. in 5 minutes to 0.7 cc. over a like period; plasma volume dropped from 3000 cc. to 2240 cc. and body

weight fell from 85.6 to 83.0 k. Marked thirst was noted after 24 hours without water when the salivary flow had diminished to one half its normal value. Sucking a lemon and, to a lesser extent, holding water in the mouth alleviated the thirst. The salivary flow returned to 4 cc. in 5 minutes, the plasma volume to 2900 cc., and the body weight to 85.0 k. after a fluid intake of 2400 cc. over a 4 hour period. It is suggested that salivary secretion is reduced by decrease in blood volume.

Grevel, S. D. S., and N. G. Mukherji, 1950. LOW ISO(HAEMAGGLUTININ)GEN CONTENT OF SALIVA IN CALCUTTA. *Indian Jour. med. Res.*, 38 (1): 89-94.

The iso-hemagglutinin neutralizing power of saliva was tested on 50 salivary samples obtained from Calcutta Indians of blood groups A, B, and AB. Generally, most of the salivas (in various dilutions) did not neutralize the sera of Rh iso-immunized subjects. However, saliva (1 to 8 dilution) from one subject of blood group A and the salivary samples (1 to 4 dilutions) from nine persons of blood groups A (3) and B (6) neutralized the iso-hemagglutinin-containing sera. Fifteen individuals were found to be non-secreters.

Tabulations revealed that there was no detectable correlation existing between complexion and diet, and salivary iso-hemagglutinin content.

Griffié, R. A., R. Ruffieux, and G. Chardon, 1944. LA VISCOSITÉ DE LA SÉCRÉTION SALIVAIRE, ENTRETEÑUE PAR LE NITRATE DE PILOCARPINE, AU COURS DES VARIATIONS DE LA VENTILATION PULMONAIRE [The viscosity of salivary secretion, maintained by pilocarpine nitrate, during variations in pulmonary ventilation]. *Comp. rend. Soc. Biol.*, 138 (23-24): 1078-1079.

The relationships between the viscosity of salivary secretion and both respiratory gaseous exchange and rate of flow were studied in the dog under nembutal anesthesia. Data were collected on arterial pressure, on respiration, and on salivation from the cannulated, denervated submaxillary gland, which was stimulated by continuous intravenous injection of 11 g./min./kg. of a 1:100,000 solution of pilocarpine nitrate. The CO₂ and O₂ pressures were varied either alone or simultaneously in inhaled air, or the animal was subjected to reduced air pressure. Results showed that viscosity changes in the saliva are not apparent when elimination of blood CO₂ is accelerated by a drop in atmospheric pressure equivalent to 14,000 m. of altitude, if the O₂ partial pressure is held near normal. Oxygen deficiency retards salivation but produces no marked change in salivary viscosity. Little change in viscosity was noted when anoxia was associated with hypocapnia. If rarification of O₂ has been carried up to a temporary stop in salivation a return to normal with reestablished salivation causes no increase in viscosity. Variations in viscosity of the saliva were significant during hypercapnia, when the inhaled mixture contained 4 to 15 p./100 of CO₂. A notable increase in viscosity occurred whenever retarded salivation returned to normal rate of flow. Where lack of O₂ is associated with hypercapnia the viscosity increase is of short duration; if sufficient O₂ is added to the inhalant mixture and inhalation is of long

duration, viscosity attains at first an almost constant elevated index, during inhalation, then after a phase of decreased viscosity, grows and declines with maxima always a certain time after a new acceleration in flow.

Griffié, R. A., R. Ruffieux, and G. Chardon, 1945. LA VISCOSITÉ DE LA SÉCRÉTION SALIVAIRE, ENTRETEÑUE PAR LE NITRATE DE PILOCARPINE, AU COURS DES VARIATIONS DE LA VENTILATION PULMONAIRE. [The viscosity of salivary secretion maintained by pilocarpine nitrate in the course of variations of pulmonary ventilation]. *Compt. rend. de la Soc. Biol. (Paris)*, 138 (23-24): 1078-1079. 1944 (publ. 1945).

Experiments on dogs under nembutol anesthesia showed that the viscosity of saliva elicited by intravenous injection of pilocarpine (11 g. of 0.001% solution/min./kg. body weight) was not changed by variation in respiratory oxygen uptake. Lack of oxygen did, however, moderate the sialorrhea produced by pilocarpine in the denervated gland. Viscosity increased when hypercapnia was induced by changing the mixture of inhaled air.

Grimbert, L., 1919. SUR LA DÉTERMINATION DU POUVOIR AMYLOLYTIQUE DE LA SALIVE [On the determination of the amylolytic power of saliva]. *Compt. rend. de la Soc. de Biol. (Paris)*, 82 (9): 312-315.

The variety of methods used to measure the amylolytic power of saliva makes it impossible to compare results. A standardized test is suggested which includes the type of starch used (potato), the concentration (5%), its manner of preparation (described in detail), the experimental temperature (37°-38°C), the duration of a test (1 hour), the volume of saliva (4 cc), determination of maltose formed, and interpretation of results.

Groshikov, M. I., 1953. O SODERZHANII PIROVIN-OGRADNOI KISLOTY V SLIUNE PRI KARIESE [On the content of pyroracemic acid in the saliva in cases of dental caries]. *Stomatologiya*, 1: 17-20.

Study was made of the presence of pyroracemic acid in saliva and its relation to the content in blood and to dental caries. Samples of 5 to 6 cc. of "mouth water" (without preliminary rinsing) and of parotid saliva (by means of the Iushchenko-Krasnogorskii's cap), and 1 cc. of blood were taken before breakfast. The pyroracemic acid content was determined by Lou's modified method with 2-4 dinitrophenylhydrosin. In 46 people, 80 tests of "mouth water," 68 tests of parotid saliva and 30 blood tests were made.

Pyroracemic acid was found in every sample. Its content in saliva was 3 to 4 times lower than in the blood; in the mouth water somewhat lower than in parotid saliva: from 0.18 to 0.96 mg./100 in blood.

Comparing the groups of people with intact teeth, those with occasional and those with multiple caries, no relationship between the pyroracemic acid content and the degree of caries could be established. The highest figures of content were actually found in the group with intact teeth.

Grosse, V. F., 1928. ESCHÉ O "SLIUNNYKH TEL'-TSAKH" [More on "salivary corpuscles"]. *Odontol. Stomatol.*, Moskva, 6 (3): 10-12.

Prior study (Grosse and Krupnikova, 1927) was continued with regard to salivary corpuscles to determine their origin. The corpuscles were considered to be polymorphonuclear leukocytes, especially neutrophils, on the basis of size, staining characteristics, and numbers. Leukocytes obtained from the blood of a subject was studied microscopically while suspended in his saliva. The leukocytes were observed to lose their protoplasm after 10 to 15 minutes and to change from their usual appearance to that of salivary corpuscles; a cover slide, hanging drop, and Giemsa stain techniques were employed. Erythrocytes in the preparation usually became hemolyzed. In tests of phagocytosis 2 drops of the washed leukocytes were mixed with 2 drops of culture of staphylococcus obtained from the oral mucosa, 0.85% NaCl, and 2 drops of the subjects blood serum; parallel tests were conducted substituting fresh saliva or sterilized saliva for the blood serum. Incubation at 37°C for an hour showed phagocytosis only in the tube containing the blood serum. It is concluded that phagocytosis in the oral area occurs only in oral tissues and not in the mouth as only dead phagocytes were found in the oral cavity.

Grosse, V. F., and E. E. Platonov, 1928a. O REAKTSII SLIUNY [On salivary reaction]. *Odontol. i Stomatol.*, 6 (7): 7-18.

Salivary pH determinations by means of litmus paper or the Michaelis colorimetric method were made in young children, in adolescents and in adults with or without an oral pathological condition. The salivary reaction in the newborn was usually alkaline prior to lactation, then shifted toward neutral on the start of nursing. Repeated tests of nursery infants a few days of age showed a neutral or weakly acid saliva, and relative dryness of the mouth before feeding, weakly acid up to 2 hours after feeding before a return to a neutral salivary reaction; the reaction was always acid during burping. Tests in 73 infants, aged from 3 to 15 months, showed a majority to have neutral to weakly alkaline saliva; 11 cases of the younger group showed an acid reaction without connection to pathological condition; 10 cases of dyspepsia showed weakly alkaline saliva in 2, neutral saliva in 4, weakly acid in 3, and acid in one case. Tests in 67 children, aged one to five years, showed weakly alkaline saliva 2 hours after a feeding without regard to age, sex, or amount of dental caries. Tests in 100 children, aged 6 to 13 years, showed a salivary pH range of 6.8-7.8 unrelated to age or sex; 9 children showing caries immunity has a pH range of 7.2-7.8. Lactation was found to shift salivary reaction from neutral to acid, and dentition, a shift from neutral to alkaline saliva in young children. The salivary pH in adolescents was found similar to that of adults, the majority ranging from pH 6.6 to 7.2 with individual test variations dependent on intake of various substances or body condition. The salivary pH in 600 cases of dental caries varied from 6.4 to 7.6 and averaged 6.8 without apparent dependence on age, sex, or extent of caries. The pH in 27 cases of stomatitis varied from 6.8 to 7.2 before treatment and became 7.0 after treatment and rapid cure or tended toward 7.0 in protracted cases. Thirty-three cases of gingivitis showed an average of pH 6.8 to 7.6 which tended toward the neutral point during the healing period. Twenty-one

cases of pyorrhea alveolaris showed the pH to vary from 6.6 to 7.4 and to average around 7.0 during treatment except in resistant cases which remained at 7.2 to 7.4. Variations in pH were attributed to local causes. Eighty-two bakery workers (26 with caries) showed a pH range from 5.8 to 7.0 averaging 6.6; 234 pastry workers (including 51% of the gingivitis cases, 7% of pyorrhea cases) showed a salivary pH range of 5.4 to 7.0, averaging 6.4. The author concludes that the usual dental diseases produce no great salivary changes, only very drastic extraneous influences can substantially affect the salivary pH.

Grossman, Louis I., and Bernard M. Brickman, 1937. SOME OBSERVATIONS ON THE pH OF SALIVA. *Jour. dent. Res.*, 16 (5): 409-416.

Salivary pH studies were made by means of an electrometric apparatus (including a saturated calomel cell and Cullen quinhydrone electrode).

The range of pH of saliva was determined to be between 5.0 and 8.0.

The pH level for each individual studied (number not given) varied in health and disease, being definitely lower during ill health. The average pH for healthy individuals was 6.7; for the diseased, 6.4.

The normal salivary pH levels of 3 subjects, taken 10 months after the first pH readings, were fairly constant in the same individual (varying about 0.1 pH); the pH level varied among different individuals, averaging 7.0, 6.8, and 6.5 respectively, for 24 hours.

Twenty-four hourly observations of a controlled group of 25 persons showed the pH of nocturnal saliva (average 6.4) to be lower than that of diurnal saliva (average 6.7).

The pH determinations on 15 subjects made an hour before and an hour after eating indicated that there is a drop in salivary pH after eating; a pH rise may precede the drop.

(Advance abstract: Observations on pH of saliva. *Jour. dental Res.*, 16 (4): 324. 1937)

Grossman, Louis I., and Bernard M. Brickman, 1937. A comparison of diurnal and nocturnal pH values of saliva. *Jour. dental Res.*, 16 (3): 179-182.

Saliva samples were collected from 3 groups of individuals at various times of day and night, and a comparison of pH values was made.

In Group I, comprised of 2 apparently healthy individuals (the authors), the subjects were awake and active during day and night; the average pH for the entire period of study was 6.7, with no apparent differences between diurnal and nocturnal values. In Group II, 25 salivas from healthy dental students averaging 8 hours sleep at night, showed an appreciable drop in pH for nocturnal saliva: the pH during the day averaged 6.7, during the night, 6.3. Group III, comprised of 11 ambulant and non-ambulant patients, showed similar variations in pH: the diurnal pH was 6.3, the nocturnal, 6.1. The average pH values for Groups I and II were higher than those of Group III; the author suggests the possibility that this is attributable to the increased activity of Groups I and II.

Grossman, Louis I., and Bernard M. Brickman, 1937b. SOME OBSERVATIONS ON THE pH OF SALIVA. *Jour. dental Res.*, 16 (5): 409-416.

Salivary pH studies were made by means of an electrometric apparatus (including a saturated calomel cell and Cullen quinhydrone electrode).

The range of pH of saliva was determined to be between 5.0 and 8.0.

The pH level for each individual studied (number not given) varied in health and disease, being definitely lower during ill health. The average pH for healthy individuals was 6.7; for diseased, 6.4.

The normal salivary pH levels of 3 subjects, taken 10 months after the first pH readings, were fairly constant in the same individual (varying about 0.1 pH); the pH level varied among different individuals, averaging 7.0, 6.8, and 6.5 respectively, for 24 hours.

Twenty-four hourly observations of a controlled group of 25 persons showed the pH of nocturnal saliva (average 6.4) to be lower than that of diurnal saliva (average 6.7).

pH determinations on 15 subjects made an hour before and an hour after eating indicated that there is a drop in salivary pH after eating; a pH rise may precede the drop.

Grossman, Louis I., and Bernard M. Brickman, 1937c. A COMPARISON OF DIURNAL AND NOCTURNAL pH VALUES OF SALIVA. *Jour. Amer. dental Assoc.*, 24 (7): 1137.

Essentially a summary of the previous paper, Grossman 1937, in which a perceptible drop in salivary pH during sleep was recorded. For three groups of individuals tested over a 24-hr. period, the average pH in the first group was 6.7 both during day and night; in the second group, 6.7 during the day and 6.4 during sleep; and in the third group, 6.3 during the day and 6.1 during sleep.

Grossman, Louis I., 1940. STUDIES ON THE LOCAL FACTORS IN DENTAL CARIES. *Jour. Amer. dent. Assoc.*, 27 (11): 1846-1847.

A criticism of Hanke (1940). In discussing the buffering power of saliva in vivo, pH determinations of the author are cited showing the salivary pH to be generally around 6.5. In a few cases where the subject had eaten chocolate or candy 15 minutes before a test the salivary pH was depressed from 0.4 to 0.6 followed by a return to normal in less than two hours.

Grove, Carl J., and Carl T. Grove, 1935. CHEMICAL STUDY OF HUMAN SALIVA INDICATING THAT AMMONIA IS AN IMMUNIZING FACTOR IN DENTAL CARIES. *Jour. Amer. dental Assoc.*, 22 (2): 247-252.

The variations in the chemical constituents of saliva of caries-immune and caries-susceptible individuals were studied. Paraffin-activated saliva was used in the analyses.

In caries-immune individuals the ammonia content (estimated by the permutet method) of the saliva was high; in susceptible persons it was decidedly and consistently lower. Observations indicated that caries does not exist if the ammonia content is above 5 mg./100 cc. of saliva. Estimations made of the calcium, phosphorus, chlorine contents, pH, titratable acidity, and alkaline reserve, showed no significant variation between the immune and susceptible persons.

The power of ammonia in dissolving salivary mucin was demonstrated by precipitating mucin from the saliva with acetic acid. The resulting

mucin was then washed with distilled water and shaken with an ammonia or other solution for 1 minute. This mixture was filtered and the filtrate tested for protein by the xanthoproteic (Mulder's) test. Mucin was soluble in ammonium hydroxide, ammonium carbonate, and sodium hydroxide; slightly soluble in sodium and ammonium phosphate, ammonium sulfate, calcium chloride, ammonium phosphate, and ammonium chloride; and nonsoluble in ammonium acetate, ammonium oxalate, and distilled water.

The practical application of salivary examination for ammonia as a diagnosis for caries is emphasized.

Grove, Carl J., and Carl T. Grove, 1941. SALIVARY AMMONIA. *Jour. dental Res.*, 20 (3): 275-276.

"Bunting, Jay and others have found that lactobacillus, under the protection of the mucin plaque, forms acid of sufficiently low pH to break down enamel, and Belding and Belding and others have contended that acid producing streptococci are the responsible agents. It is generally agreed that there is an immunizing factor or factors in saliva of immune individuals that prevents formation of mucin plaques and inhibits growth of acidogenic organisms. In 1934 we presented work indicating that the ammonia of saliva is an inhibiting agent. Where caries is rampant, the ammonia content of saliva is very low, and where caries is mild or absent, it is high. The Folin-Bell-Permutite procedure was employed for ammonia nitrogen determinations. Our further studies have proven that ammonia in solution is a solvent of salivary mucous and mucous plaques and obviously an inhibitor of growth of lactobacillus. Ten cc. of a 0.1 per cent solution of ammonia will dissolve 300 mgm. of dried salivary mucin. Criticism has been made by White and Bunting and Youngburg of the method we employed. They contend that an aeration procedure for determination of ammonia nitrogen is preferable and more accurate. Further research has indicated that their basis for criticism is not well founded. The Folin-Bell Permutite method calculates only non-protein nitrogen (ammonia) while the aeration method calculates nitrogenous bases other than ammonia." (Complete paper.)

Grove, Carl J., and Carl T. Grove, 1942. ACTION OF AMMONIA ON LACTO-BACILLUS AND SALIVARY MUCIN. *Jour. Amer. dental Assoc.*, 29 (9): 1215-1216.

The solubility of salivary mucin in an ammoniacal solution, comparable to that found in the mouth, was tested using dried salivary mucin. 300 mg. of dried mucin were mixed with 10 cc. of a 0.006% solution of ammonia and then allowed to stand 24 hours. The solution was observed to be approximately 98% efficient as a solvent of salivary mucin, as only a slight trace of the mucin had precipitated after 24 hours.

A simple colorimetric method was employed to demonstrate the action of the ammonia solution on oral lactobacilli. 50 tubes containing glucose-agar and a bromocresol green indicator with a pH of 5.4 were prepared. 0.2 cc. of saliva was added to each of the 50 tubes. To 25 of these tubes was also added 0.2 cc. of a 0.006% ammonia solution. The tubes had been preheated to 45°. All the tubes were then shaken, cooled, and placed in

an incubator at 37° C. Bromocresol green indicator at pH 5.4 is green. If there is no activity of the lactobacilli, the color remains green. If there is activity of the organisms resulting in acid formation, the green turns yellow. Of the tubes in which no ammonia had been added, 80% turned yellow in 24 to 48 hours; all of the tubes containing ammonia remained green up to 72 hours.

Grove Carl T., and Carl J. Grove, 1934. THE BIOCHEMICAL ASPECT OF DENTAL CARIES. *Dental Cosmos*, 76 (10): 1029-1036.

A series of analyses of paraffin-stimulated saliva (estimating ammonia, urea, titratable acidity, alkaline reserve, and pH) indicate a higher salivary ammonia content among relatively caries-immune individuals than exists in a caries-susceptible group. The titratable acidity of saliva in caries-susceptible cases was generally found to be greater before removal of ammonia by permutit than after, while in caries immune cases the titratable acidity was less before removal of the ammonia than after. The unexplained difference is taken to indicate a decided difference in the make-up of the two salivas. The immunizing property of ammonia, in the form of alkaline ammonium salts, is apparent when the salivary pH is above 7, and the ammonia level is above 4 mg./cc. of saliva. Experiments on acetic acid-precipitated mucin showed the mucin to be soluble in a .005% ammonium hydroxide solution, in 1% solutions of sodium hydroxide and ammonium carbonate, and slightly soluble or insoluble in several other calcium, sodium, and ammonium salts. Tests in which 5 cc. of 1% solutions of various compounds each allowed to stand overnight with 10 cc. of fresh saliva showed the test tube containing ammonium hydroxide to be clear, all sediment precipitated to the bottom of the tube. The remaining tubes to a greater or lesser extent were cloudy, with adherent particles on the sides of the tubes. The ammonium hydroxide is considered to destroy the sticky, adherent properties of the saliva. Mouth washes containing a .006% ammonia solution were observed to retard plaque formation.

Grove, Carl T. and C. J. Grove, 1935. AMMONIUM CONTENT OF SALIVA. *Jour. dent. Res.*, 15 (3-4): 176.

Analysis of the saliva of 150 caries-immune and caries-susceptible individuals, using the permutit method, indicated that the ammonium content in the saliva of caries-susceptible mouths was low (0 to 6 or 7 mgm. per 100 cc. of saliva) while that of caries-immune mouths was high (8 to 20 mgm. per 100 cc.).

It is suggested that the lack of agreement between salivary ammonia values determined by the permutit method and by an aeration method (White, J., 1936) indicates measurement of different products. Because of the high protein content of saliva, the permutit method may estimate nitrogen other than that of ammonia. The permutit method shows significantly higher values for a nitrogenous product in saliva of caries-immune mouths than in saliva from caries-susceptible.

Grubb, R., and B. Krasse, 1954. SAMPLING METHODS FOR THE DETERMINATION OF THE NUMBER OF LACTOBACILLI IN THE ORAL CAVITY. *Acta odontol. Scandinav.*, 12 (2): 145-156.

Three methods of passive sampling for lactobacilli counts of the mouths of mentally defective patients at Viperholm Hospital, Lund, were investigated. A swab method and a toothbrush method were found inferior to a spoon method which compared favorably in 127 parallel tests with the Hadley (1933) method utilizing paraffin-stimulated saliva.

Grubb, Thomas C., 1945. STUDIES ON THE FERMENTATION OF SORBITOL BY ORAL MICROORGANISMS. *Jour. dental Res.*, 24 (1): 31-44.

Assuming that *Lactobacillus acidophilus* is a primary factor in the etiology of dental caries because of its fermentative action on sucrose and dextrose, the effect of *L. acidophilus* on sorbitol in saliva was studied. In 122 salivary samples, sorbitol was fermented much more slowly than the other sugars; it was suggested that sorbitol be substituted for sucrose and dextrose in the sweetening of foods.

Gubenko, V. K. 1942. O RODANISTYKH SOEDINENIĖKH V SLIUNE I SPINNOMOZGOVOI ZHIDKOSTI SOBAK. [On thiocyanates in the saliva and spinal fluid of dogs]. *Biull. eksper. Biol. i Med.*, 13 (3-4): 102-104.

Study was made in the parotid secretion of 10 dogs to determine the presence of thiocyanogen compounds.

Examination of parotid secretion immediately after a rest period of at least one hour always revealed the presence of thiocyanates in the first two salivary samples (of 1 cc.) in the third and fourth samples however, this substance had already disappeared. The amounts found varied in the different dogs from traces to 2 mg., sometimes 3 mg./cc. of saliva. Thiocyanates are found seldom and only in traces in the submaxillary and sublingual glands.

After injection of KCNS into the blood stream there was a marked increase of this substance in parotid saliva. In submaxillary and sublingual saliva this increase is noticed only after injection of a large dose of thiocyanate (0.5 g.). The amount injected determined the result also in parotid saliva; thus, in one case, after intra-arterial injection of 0.1 g. of KCNS this substance did not appear in the saliva; after injection of 0.5 g. to the same dog, the saliva abounded in thiocyanate for 26 hours.

Thiocyanate was equally found in the spinal fluid in similar quantities.

Gruber, Charles M., 1915. THE THRESHOLD STIMULUS OF THE CHORDA TYMPANI NERVE IN RELATION TO SALIVARY SECRETION AND VASODILATION. *Amer. Jour. Physiol.*, 36 (3): 299-304.

Dogs were anesthetized with ether and quickly decerebrated. The chorda tympani nerve and the submaxillary duct were exposed. The Wharton duct was cannulated and the rate of salivary secretion was indicated by a recording tambour. The external jugular vein was also cannulated and the blood flow recorded in the same manner. The chorda tympani was stimulated by currents from an induction coil. The threshold stimulus was measured by the Martin method in which the strength of the stimulus is calculated in Z units and β units (Martin, Ernest G., Measurement of induction shocks. New York: John Wiley and Sons, 1912). The secondary coil was moved away from the primary coil until the

smallest amount of vasodilation or of salivary secretion occurred. The strength of the primary current for determining this threshold was either 0.1 or 0.2 amperes at a rate of stimulation of usually 5 per sec.

The strength of the stimulation of the chorda necessary to produce secretion also produced vasodilation in every case. The threshold stimulus in Z units varied from 2.2 to 12.80 or an average of 5.4 Z units for the 16 experiments performed. In β units the variation was from 1.6 to 7.58 or an average of 3.14 β units.

Guimaraes, Alfonso, 1930. A PROPOS DE LA PROPRIÉTÉ EXCITATRICE DE LA SÉCRÉTION DE LA SALIVE. EXPÉRIENCES SUR LA GLANDE SOUS-MAXILLAIRE DUE CHIEN APRÈS SECTION DE LA CORDE DU TYMPAN [Concerning the secretagogue properties of saliva. Experiments on the submaxillary gland in the dog after section of the chorda tympani]. Compt. rend. Soc. Biol. (Paris), 105: 463.

Injection of 5 cc. of a 30% saliva dilution into the artery supplying the submaxillary gland in the dog caused a spontaneous abundant secretion by the gland. Stimulation applied to the chorda, which had been sectioned five years earlier, produced no salivation; the nerve fibers were considered to be degenerated. It is suggested that the secretagogue principle of saliva affects the secretory cells directly.

Guimaraes, Alfonso, 1930a. ACTION DE SALIVES HÉTÉROLOGUES ET DE L'EXTRAIT ALCOOLIQUE DE SALIVE SUR LA SÉCRÉTION SALIVAIRE CHEZ LE CHIEN. INFLUENCE DE LA TEMPÉRATURE SUR LES PROPRIÉTÉS EXCITATRICES DE LA SALIVE ET DE SON EXTRAIT ALCOOLIQUE. [Action of heterologous salivas and of the alcoholic extract of saliva on salivary secretion in the dog. The effect of temperature on the stimulatory principle of saliva and of its alcoholic extract]. Compt. rend. Soc. Biol. (Paris), 105: 464-465.

Carotid injection in the dog of Locke's solution containing 25 to 50% of either human or bovine saliva produced a salivary secretion similar to that previously stimulated by injection of canine saliva. The stimulatory substance in saliva is thus considered to be non-specific. Injections in the dog of an alcoholic extract of chorda saliva of the dog, diluted with Locke's solution, likewise produced salivation, a few moments after injection, which was occasionally very strong and prolonged. Experiments were conducted in the dog in which various dilutions of human and of canine saliva were heated for 45 minutes at different temperatures prior to carotid injection. Saliva heated above 60° C. was found inactive although injections of the same but non-heated saliva into the same animal before or after the test always produced salivation. Similar results were obtained with alcoholic extracts of the salivas.

Guimaraes, Alfonso, 1930b. INFLUENCE DU SANG ET DE LA SALIVE SUR LA SÉCRÉTION SALIVAIRE [The influence of blood and of saliva on salivary secretion]. Compt. rend. Soc. Biol. (Paris), 104: 804-805.

A description is given of the technique and results of experiments on perfusion of the salivary gland in the dog, anesthetized with an ether-chloroform-alcohol mixture. Tests in 15 dogs having the submaxillary gland irrigated with either

normal or glucose Locke's solution showed the gland to cease secretion in response to chorda stimulation after a 37 to 75 minute period of excitation of the nerve. Reestablishment of the normal blood supply to the gland was followed, after a 10 minute period, by a return of submaxillary secretion in response to chorda stimulation. It is concluded that blood is necessary for the normal response of the gland to nerve excitation. Nerve stimulation was required for salivation in these tests.

Use was made of Locke's solution containing either blood serum or whole blood of the animal in a second series of tests. The enriched perfusion fluid produced no spontaneous flow of saliva; stimulation of the chorda produced normal flow. When this flow ceased, substitution of a fluid containing Locke's solution, serum, and chorda-stimulated saliva revived the flow subsequent to chorda stimulation. Spontaneous salivation occurred in the gland irrigated with the Locke's solution-serum mixture when 20 cc. of a 1:5 dilution of saliva in Locke's solution was injected into the external carotid artery. Such injection over a 2-minute period immediately produced spontaneous flow which persisted for 15 minutes.

Guimaraes, Alfonso, 1932. SÉCRÉTION SALIVAIRE ET PILOCARPINE [Salivary secretion and pilocarpine]. Compt. rend. Soc. Biol. (Paris), 110: 1049-1051.

Intravenous administration of 0.01 gm. of pilocarpine in a dog, whose exhausted submaxillary gland was no longer responsive to chorda stimulation, resulted, after 10 seconds, in the establishment of an abundant flow of saliva which persisted for 15 minutes.

Injection of 0.01 gm. of pilocarpine into each of two dogs, having a severed and degenerated chorda tympani, produced a similar flow of submaxillary saliva.

It is concluded that the pilocarpine acts on the secretory cells themselves rather than on the terminal fibers of the chorda tympani.

Guimaraes, Alfonso, 1932a. PROPRIÉTÉS EXCITATRICES DE LA SÉCRÉTION SALIVAIRE DANS LA SALIVE SÉCRÉTÉE SOUS L'INFLUENCE DE L'INJECTION DE SALIVE TYMPANIQUE ET DE LA SALIVE OBTENUE PAR L'ACTION DE LA PILOCARPINE [Sialogogic properties of saliva secreted under the influence of an injection of chorda tympani saliva and of saliva obtained by the action of pilocarpine]. Compt. rend. Soc. Biol. (Paris), 110: 1046-1048.

A description is given of experiments investigating sialogogic substances of certain salivas in the dog with severed chorda tympani and anesthetized either with a ether-chloroform-alcohol mixture or with Numal [allylisopropyl barbituric acid]. Intra-carotid injection in 2 dogs of saliva (secreted in response to chorda stimulation and diluted with Locke's solution) was followed by abundant salivation similar to that produced by chorda stimulation. The secretion was sustained for several minutes. The same procedure was used in a second experiment in 2 dogs after injection of 0.01 gm. of pilocarpine intravenously in one, intra-arterially in the other. The salivary injection produced abundant salivation similar to that evoked by pilocarpine. The active substances are considered to act upon the submaxillary gland to produce salivation, and upon

the secretory fibers of the chorda tympani to liberate active substances.

Guimaraes, Alfonso, 1932b. ACTION DE L'ATROPINE SUR LA GLANDE SOUS-MAXILLAIRE [The effect of atropine on the submaxillary gland]. *Compt. rend. Soc. Biol. (Paris)*, 110: 1048-1049.

Six of 8 dogs, anesthetized with an ether-chloroform-alcohol mixture, were given carotid artery injections of either 0.2, 0.1 or .001 mg. of atropine. Of the two remaining dogs, one was injected with 0.01 mg. of atropine subcutaneously, the other 5 mg. intravenously. Stimulation of the chorda tympani 2 to 4 minutes after the injection was followed by a feeble secretory response only in dogs receiving the .001 mg. dose of the alkaloid. Carotid injections of 10-20 cc. of 10%, 20%, and 50% dilutions of chorda saliva in Locke's solution likewise produced no secretory response after atropine. Carotid injection of 5 cc. of chorda saliva (in 5 cc. of Locke's solution) and a very small amount of atropine induced no salivation in a dog with a severed and degenerated chorda tympani. Intravenous injection of 0.01 gm. of pilocarpine, however, stimulated the inhibited gland to a very abundant secretion. It is concluded that atropine inhibits the response of the salivary gland cells to the secretagogue substances of saliva.

Guimaraes, J. A., 1936. THE SECRETAGOGUE AND DEPRESSOR SUBSTANCES IN SALIVA AND PANCREATIC JUICE. *Jour. Physiol.*, 86 (1): 95-108.

The secretory effects induced by saliva, secreted after parasympathetic or sympathetic stimulation, were studied in cats and dogs, anesthetized with dial or other anesthetics and having the chorda tympani, the cervical sympathetic nerve, and vagus cut on both sides.

Arterial injection of 0.25 to 1.0 cc. cat's sympathetic-induced saliva, diluted with 4 cc. of Locke's solution, into the submaxillary gland of the dog produced salivation at a rate similar to that produced by weak chorda stimulation and proportional in volume to the amount of saliva injected. A marked depressor effect, greater than that produced by parasympathetic saliva, preceded and usually outlasted the secretory effect. Similar effects were produced in the cat by injection of either sympathetic or parasympathetic saliva of the cat or parasympathetic saliva of the dog. The secretion in the cat was less than that produced by the same amount of the same sample injected into the dog. No proportionality was noted between the secretagogue and depressor effects. Tests of trichloroacetic extracts of dogs parasympathetic saliva showed these to have no depressor effect in the cat. Alcoholic extracts of cat's sympathetic saliva and dog's parasympathetic saliva produced a depressor effect in the cat about 1/20 of that produced by untreated saliva. The alcoholic extracts produced secretory and depressor responses in the dog less pronounced than those induced by the original saliva. Arterial injection of acetylcholine into the submaxillary gland of the dog or cat produced a secretory response which was exceeded by similar injection of acetylcholine and saliva. Saliva is considered not to antagonize the secretory effect of acetylcholine.

Further experimentation, on the pancreas, showed stimulated pancreatic juice to contain

substances exciting pancreatic secretion and producing depressor effects. Pancreatic juice had no stimulatory effect on the submaxillary gland while saliva had only trivial secretory effect on the pancreas.

It is concluded that the secretagogue substance of saliva is specific to the gland, is not acetylcholine, and is not identical with the depressor substance. The salivary secretagogue is considered to come from the salivary secretory cells, present in the resting cells in an inactive form.

Guinard, L., 1893. INFLUENCE DE L'APOCODEINE SUR LES SECRÉTIIONS, SUR LE PÉRISTALTISME INTÉSTINAL ET SUR LE SYSTÈME NERVEUX [The influence of apocodeine on the secretions, on intestinal peristalsis, and on the nervous system]. *Compt. rend. de la Soc. de Biol. (Paris)*, 45 (22): 664-666.

Apocodeine causes salivary hypersecretion in the dog and cat. Sectioning of the chorda tympani abolished this effect, showing that apocodeine affects the central nervous system rather than the peripheral (either glandular or nervous) systems.

Guinard, L., 1895. A PROPOS DE L'ACTION EXCITO-SÉCRÉTOIRE DE LA MORPHINE SUR LES GLANDES SALIVAIRES ET SUDORIPARES [Regarding the stimulatory action of morphine on the salivary and sweat glands]. *Compt. rend. de la Soc. de Biol. (Paris)*, 47 (16): 370-372.

A comparative study was made of the effects of morphine on salivation and sweating in the dog, cow, goat, sheep, pig, cat, horse, donkey and man.

In the dog morphine elicits saliva only at the beginning when the drug starts to take effect; salivation may continue longer if the doses are weak.

In the cow, goat, sheep, pig, and cat, morphine is not a hypnotic; it produces exaggerated salivary secretion. In the horse and donkey, abundant sweating replaces sialorrhea.

In man morphine may cause a little salivation at the beginning, especially if the dose is weak; sweating is the dominant secretory modification.

Morphine appears to act directly on the secretory nerve centers. In the dog with a unilaterally severed chorda tympani morphine will stimulate saliva flow only on the intact side. In the goat likewise cutting the nerve to the parotid gland on one side prevents flow on that side while the gland in the intact side secretes actively. During experiments on the foot pads of the cat it was noted that sectioning the sciatic nerve blocked the sweat-producing action of the drug.

Günther, V., 1941. ÜBER DIE WIRKUNG DER SPEICHELAMYLASE VOR UND NACH TONSILLECTOMIE [On the action of the salivary amylase preceding and following tonsillectomy]. *Hoppe Seyler's Zeitschr. physiol. Chem.*, 270 (3-4): 153-157.

The diastatic power of mixed saliva was measured in eight patients just before tonsillectomy, and then on the fourth day after surgery. In eight other patients the test was repeated on the twelfth and fifteenth day after operation, and after four to five weeks. Results showed great variation. In certain cases there were considerable fluctuations in the enzyme content. In other cases no changes occurred. Eigler's finding indicating a considerable enzyme decrease on the

twelfth or thirteenth day, could not be confirmed.

Gureev, T. T., A. K. Pislegin, E. I. Shulman, 1937. ROL' TSENTRAL'NOI NERVOI SISTEMY V RAZVITII PROTSESOV ISTOSHCHENIYA I VOSSTANOVLENIYA PO OPYTAM NA SLIUNNYKH ZHELEZAKH [The role of the central nervous system in the development of the processes of exhaustion and restoration in experiments on the salivary glands]. VI Vsesoiuz. S'ezd Fiziol., Biokhim. i Farmakol. Sbornik Dokladov, Tbilisi, 1937, Oct. 12-18, p. 737-740.

Changes in submaxillary and sublingual saliva were studied in a fistulated dog during prolonged food stimulation. The animal was fed 4 gm portions of rusk at 10-second intervals for 2 to 3 hours; 80 to 132 cc of saliva were collected in 5-minute samples and determinations made of the amount of saliva, its dry residue, organic matter and ash. Samples were taken on the days following such stimulation until normal salivation was restored. Results showed no substantial change in rate of flow or in ash content but a steady decrease up to 38% was found in the organic content of saliva elicited during prolonged secretion. The salivary composition returned to normal on the fourth to fifth day after stimulation. Similar results were obtained by eliciting a continued minimal rate of salivation through stimulation applied to the oral mucosa, or to the eye, nose or ear, pilocarpine stimulation evoked a larger flow of saliva with a greater amount of organic matter than food stimulation but produced no change in composition with prolonged flow. Consecutive stimulation during 2 to 3 hours with different types of foods produced no glandular exhaustion, if food stimulants were changed on appearance of salivary alteration. Natural conditioned salivary reflexes disappeared and unconditioned reflex values decreased under the experimental conditions but could be restored by inducing disinhibition or by acid-stimulation. The drop in the salivary organic content is attributed to inhibition processes in the cerebral cortex and not to depletion of the salivary glands. (From authors' abstract)

Gurney, B. F., and G. W. Rapp, 1948. CHANGES IN SALIVARY CALCIUM AND PHOSPHATE AFTER HISTAMINE INJECTIONS. Jour. Dental Res., 27 (6): 760.

"Changes in salivary calcium and phosphate, following intramuscular injections of histamine phosphate in fasting patients and in those fed a test meal, were investigated. The object was to determine the role that gastric secretion plays in affecting changes in salivary calcium and phosphate concentrations. This work was undertaken to test the hypothesis that gastric juice secretion has a "reservoir-draining" effect on the salivary calcium and phosphate output." (Author's abstract)

Gurney, B. F., 1948a. A DIETARY ASPECT OF ORAL CALCULUS. Jour. Dental Res., 27 (6): 746.

"The dietary factor of calcium, phosphate and vitamin D intake, as well as the systemic factor of gastric stimulation, was studied in relation to salivary secretion and excretion. The object was to ascertain the existence or non-existence of a mineral "tide" after ingestion of mineral-rich foodstuffs, and its bearing on the

rate of oral calculus deposition. Evidence was also gathered which demonstrates a remarkable effect that gastric stimulation has on the salivary output of several normal salivary constituents." (Author's abstract)

Gurney, B. F., 1949. A SYSTEMIC FACTOR CONTRIBUTING TO THE MINERAL TIDE IN HUMAN SALIVA. Jour. Dental Res., 28 (6): 671.

"Evidence has been accumulated that the variations in calcium and phosphorus concentrations of human saliva are quite exaggerated under conditions of controlled and uncontrolled ingestion of salts of these metals. These same fluctuations in salivary concentrations can be experimentally produced by histamine injections under proper conditions. The relation of histamine to certain systemic factors such as gastric secretion is well known." (Author's abstract)

Gurney, B. F., and J. H. Huschart, 1950. A DIETARY ASPECT OF CALCULUS. Jour. dent. Res., 29 (1): 63-67.

Paraffin-stimulated samples of saliva were collected from 10 healthy, male, dental students before breakfast. Samples were collected before, and at 15-minute intervals during the first hour after ingestion of 250 cc. of water, and at 30-minute intervals during the second hour. Determinations were made of the pH of one portion of a sample, and of the calcium and phosphate ion concentrations of the remainder after deproteinization and centrifugation. Results show no abnormal fall in ionic concentrations. Similar results were obtained after ingestion of 250 cc. of water and a placebo containing no calcium or phosphate ingredients. Substitution of 2 gm. of dicalcium phosphate and vitamin D for the placebo produced an irregular increase in the salivary calcium concentration, and a regular increase in the phosphate ion concentration. Comparison of the critical and actual pH values of the salivas showed that these ionic changes in the saliva are relatively unimportant in calculus-forming tendency of saliva if the pH values differ less than one pH unit. If the difference is more than one pH unit, concentration changes increase the tendency of saliva to deposit calculus.

Gurney, B. F., and G. W. Rapp, 1951. INTERMEDIARY CARBOHYDRATE METABOLISM IN MIXED HUMAN SALIVA. Jour. Dental Res., 30 (4): 494.

"Carbohydrate metabolism associated with caries formation has been investigated minutely. The present emphasis is not so much on the final end products, such as lactic and other organic acids, but more on the intermediary products, such as the triose phosphates and three-carbon acids other than pyruvic and lactic acid. Since the metabolic reactions are a chain of intermediate steps, the rate and extent of each step is important. The present work shows a difference in the rates and extents of intermediary metabolism found in mixed saliva of caries susceptible and caries immune subjects." (Authors' abstract)

Guyenot, E., 1907. INFLUENCE DE LA DIALYSE ET DES SELS MINERAUX SUR L'ACTIVITE DU FERMENT AMYLOLYTIQUE DE LA SALIVE [Influence of dialysis and of mineral salts on the activity of the amylolytic enzyme of saliva]. Compt. rend. de la Soc. de Biol. (Paris), 63 (39): 768-770.

Experiments showed that dialyzed human saliva was always less active in converting potato starch to sugar than normal saliva. The loss in activity was directly related to length of dialysis.

Addition of mineral salts (salts of Ca, K, Na, Mg) to the dialyzed saliva revived the amylolytic power which could be less than, equal to or greater than normal saliva, depending on the kind and amount of salts added. Calcium (as chloride or phosphate) combined with potassium proved most effective for this purpose.

Identical experiments using diastase of prepared human saliva as well as submaxillary saliva of the dog gave analogous results.

Hadden, W. B., 1888. SUPPRESSION OF THE SALIVARY AND BUCCAL SECRETIONS. *Lancet* (London), 1 (3360) 156.

A report is given of a case of dry mouth in a 65 year old woman. Treatment with tincture of jaborandi [*pilocarpus*] appeared to improve the condition.

Hadley, Faith P., R. W. Bunting, and E. A. Delves, 1930. RECOGNITION OF *BACILLUS ACIDOPHILUS* ASSOCIATED WITH DENTAL CARIES: A PRELIMINARY REPORT. *Jour. Amer. dent. Assoc.*, 17 (11): 2041-2058.

A study was made of the cultural and morphological variants (oral and intestinal) of *Bacillus acidophilus* [*Lactobacillus acidophilus*] as well as the differences in acidogenic, serologic and fermentation properties, and morphological changes (dissociation). Morphological features were noted at a pH of 5.0 and characteristics were based upon their appearances on agar; the classifications were correlated with those of other authors.

Three groups were determined - Groups I, II, and III. Of the three, Group I was the most acidogenic in litmus milk and the fermenter of the greater number of carbohydrates - Group I was a sorbitol-mannitol-salicin fermenter while Groups II and III were sorbitol mannitol-salicin-esculin non-fermenters. All three intestinal strains (833, 314, and 110) revealed characteristics in common with the Group I oral strains, and a strain of each oral group could dissociate into a rough colony resembling that of the rough forms of the intestinal bacilli. Both the intestinal and oral bacilli occurred in either rough or smooth forms. The rough forms may be associated with the formation of dental plaques.

Hadley, Faith P., and R. W. Bunting, 1932. FURTHER STUDIES ON THE RECOGNITION OF *B. ACIDOPHILUS*. *Jour. Amer. dent. Assoc.*, 19 (1): 28-36.

A comparative study was made of the growth characteristics, acid formation, frequency, and type of *Bacillus acidophilus* [*Lactobacillus acidophilus*] organisms found in the mouths and intestinal tracts of caries-susceptible and caries-free persons (17 to 24 years of age); samples were collected and cultured every 24 hours for 5 days from the subject's teeth scrapings, feces, and saliva.

Four distinct types (1, 2, 3, and 4) of *B. acidophilus* were isolated from both the intestine and oral cavity, and classified according to colony characteristics, group formation, and individual morphology.

Qualitative examinations detected the organisms (predominantly Types 1 and 3) in 100% of all three samples obtained from caries-susceptible individuals, while *B. acidophilus* was absent from the cultures of at least 20% of the fecal or salivary samples, and up to 55% of the teeth scrapings of caries-free persons. Type 1 and an "unidentified type"

(with morphological characters of Type 3 and colony features of Type 1) were most common in the caries-free group. In both groups of subjects there was a tendency for Types 1 and 3 to be found together (especially in the caries-susceptible subjects) as well as for like types to be found in all three locations.

Hadley, Faith P., 1933. A QUANTITATIVE METHOD FOR ESTIMATING *BACILLUS ACIDOPHILUS* IN SALIVA. *Jour. dental Res.*, 13 (5): 415-428.

"The need for a solid medium for quantitative determinations of oral *B. acidophilus* [*Lactobacillus a.*] in connection with studies on the bacteriology of dental caries has been met by devising a modification of Kulp's tomato-peptone agar.

"This modification involved increasing the acidity of the medium to pH 5.0, with lactic acid, and the agar content to 2 percent.

"On this medium colonies of *B. acidophilus* of the smooth, rough, and intermediate phases may be differentiated from each other, and from the other mouth organisms, such as yeast, staphylococcus, *M. tetragenus*, and occasional streptococci, which tolerate this acidity. Most streptococci and staphylococci do not grow.

"Methods for collection of saliva, dilution of the sample, and spreading on the plates are described. The number of *B. acidophilus* per cc. of saliva can thus be estimated.

"In order to secure well-distributed colonies on agar plates, saliva from caries-susceptible patients requires a much higher dilution than does saliva from caries-free patients. In the latter group it is often necessary to employ undiluted saliva.

"A group of fourteen caries-susceptible and ten caries-free children was cultured at intervals for 18 months. In the susceptible group, qualitative cultures showed *B. acidophilus* present in all cases from tooth-scrapings and from saliva. Quantitative estimations ranged from a few hundred to 500,000 per cc. of saliva, with a majority over 20,000. The average for 79 examinations was 60,000.

"In the caries-free group, qualitative cultures showed *B. acidophilus* present in only 21 percent of tooth-scrapings, but in 51 percent of salivas. Quantitative estimations of *B. acidophilus* in saliva ranged from 0 to 20,000, with a majority of counts 0--in 81 percent the counts were less than 100. The average for 69 examinations was 600.

"While *B. acidophilus* is invariably present, and usually in great numbers, in the mouths of caries-susceptible subjects, in caries-free individuals its presence is variable and usually marked by few organisms.

"By reducing carbohydrate in the diet to the lowest possible minimum, in a patient extremely susceptible to caries, *B. acidophilus* was decreased in 18 days from the very high figure of 1,800,000 per cc. of saliva to 100 per cc.

"The advantage to be gained from applying this quantitative method to comparative studies of the aciduric flora of caries-susceptible and caries-free mouths, and to studies of methods of control of aciduric overgrowths, is indicated." (Author's summary).

(Preliminary note: Hadley, Faith P., and R.W. Bunting, 1933. QUANTITATIVE METHOD FOR RECOGNIZING *BACILLUS ACIDOPHILUS* IN SALIVA. *Jour. dental Res.*, 13 (3): 198. 1933.)

Haeselaer, Kurt W., and J. Mitchell Fain, 1935. DISCOLORATION OF TEETH. Dental Cosmos, 77 (9): 878-881.

Saliva incubated at 37°C with masticated starch became distinctly acid within 2 hours. Slight pitting was noted in recently extracted, thoroughly cleaned human teeth immersed in such a mixture for a 2-week period. A 3% acetic acid solution coagulated the salivary mucin of fresh saliva; saliva left standing lost its coagulating properties. The mucin was observed to gradually separate and settle as a flocculent mass in the bottom of a test tube where it slowly formed an adherent deposit. In experiments on acetic acid-precipitated mucin as well as on mucin in fresh saliva, the coloring matter from the filtered juice of a variety of vegetables was found to be absorbed by the mucin. In an experiment in which a cigarette was mechanically smoked through 25 cc. of fresh saliva the mucin was found to contain most of the coloring matter. The tobacco tars were contained in the saliva, none adhering to the sides of the vessels. Considerable tar clung to the walls of the apparatus in a similar test in which distilled water replaced the saliva. A consideration of the chemical nature of mucin indicates that the pH of the mucin-containing medium controls the mucin-dye reaction. The tobacco tars are considered to be emulsified and precipitated by the mucin.

Haggard, H. W., and Leon A. Greenberg, 1951. THE ACIDITY OF SALIVA AFTER INGESTION OF CARBOHYDRATES AND ACID-FORMING SUBSTANCES. Jour. dental Res., 30 (1): 126-129.

The effects of certain foods on salivary pH were studied. The mouths of 16 individuals having no active caries were thoroughly cleansed and the acidity determined by means of a Beckman glass electrode pH meter. Each of the subjects was then fed each of the substances successively—fresh orange juice, grape juice, a bottled cola beverage, tomato juice, ice cream, caramel candy, crackers, and a mixed meal. Saliva samples were collected 5, 10, 15, 30, 60, and 90 minutes after feeding; pH was determined by glass electrode.

No significant change in salivary pH was caused by carbohydrate-containing substances. A short-termed acidity resulted after ingestion of acidulated beverages.

The authors express their doubt that a corrosive action may be attributed to the acidity of the fruit juices or soft drinks in normal consumption.

Hall, Ivan C., 1923. BACTERIAL FACTORS IN PYORRHEA ALVEOLARIS. I. MICROBIC CHANGES IN SALIVA. Jour. Amer. med. Assoc., 81 (20): 1676-1679. Abst. Jour. dent. Res., 6 (3): 163, 1924-1926.

Experimentation showed that microbial changes in human saliva depend primarily on the nature of the pabulum, and secondarily on the kinds of organisms present.

Hall, Ivan C., and Clayton Westbay, 1925. BACTERIAL FACTORS IN PYORRHEA ALVEOLARIS. Dental Cosmos, 67 (2): 115-124. Abst. Jour. dent. Res., 6 (3): 164, 1924-26.

A study of pH changes in human saliva induced by incubation at 37°C. showed samples from 40 subjects to reach a terminal pH value of 8.4-8.6 after several days of incubation. Similar samples with added carbohydrates all became acid under the same experimental conditions with a terminal pH of 4.6 as determined by colorimetric methods. The

changes were uninfluenced by age, nationality, or dental condition of the subject. An initial rise in salivary pH was noted in some cases during the first 3 to 4 hours, within a few minutes if the sample was tested in an open dish, followed by a return to acidity before terminal development of acidity. Repeated tests showed the initial rise in pH as not constant for a given subject and to be possibly related to release of CO₂ in the saliva sample.

In a second series of experiments using pooled saliva from 10 subjects it was found that close stoppering the samples during incubation prevents the alkaline change characteristics of raw saliva, but did not prevent the acid change on addition of saccharose to the salivary samples. A study of the calcium content of the pooled saliva at various stages of incubation showed Ca to be precipitated to a large extent after 2 days of incubation of raw saliva. No variation in total dissolved mineral content could be detected in samples incubated for varying periods of time either in rubber or cotton-stoppered tubes.

Hall, Ivan C., and Beatrice Howitt, 1925a. THE ANAEROBIC BACTERIA OF THE ORAL CAVITY. Proc. Soc. exper. Biol. Med., 22 (8): 541-543.

Fifty-five saliva samples from 43 individuals were examined for bacterial content. Sporulating aerobes were encountered in 16 samples, but were not identified because of the "present unsatisfactory status of their taxonomy" [1925]; sporulating anaerobes were found in only 6 specimens, and included Bacillus welchii [Clostridium perfringens], B. bifermentans [Clostridium b.], B. tetanomorphus [Clostridium tetanomorphum], a strongly toxicogenic B. tetani [Clostridium tetani], and an unidentified non-pathogen.

Emphasis is placed upon 24 strains of a minute, Gram-negative, non-sporulating, gas-forming obligate anaerobe which were isolated from 35 samples from 23 persons. A morphological description and cultural characteristics of the organism, which the author calls Micrococcus gazogenes [Veillonella g.], is given.

Intravenous injection of live cultures of the organism into 10 rabbits differentiates the organism into two serological groups, Group A containing 22 strains, and Group B containing 2 strains.

Powerful agglutinins, all over 1:10,000, were produced by all cultures.

Normal rabbits, although they may harbor M. gazogenes, produce no agglutinins except after inoculation; humans, on the other hand, may produce low grade agglutinating serums (1:40), the strongest of which come from persons free or practically free from gingival lesions. An immunological factor relating to this organism in pyorrhea alveolaris is suggested.

Hall, Ivan C., and Beatrice Howitt, 1925b. THE ANAEROBIC FLORA OF THE MOUTH. Abst. Bacteriol., 9 (1): 10-11.

Fifty-five saliva samples from 43 individuals were examined for bacterial content. Sporulating anaerobes occurred in only 6 samples; three strains of B. welchii [Clostridium w.], an unidentified pathogen, B. bifermentans [C. b.], B. tetanomorphus [C. t.], and a toxicogenic B. tetani [C. t.] were isolated. This is believed to be the first record of B. tetani as an oral cavity inhabitant.

Aerobes were isolated from 16 samples but were not identified. No direct pathological relation to pyorrhea is attributed them.

No spiral or fusiform organisms visible in dark field microscopy appeared in any cultures.

Emphasis is placed on the presence of 24 strains of a minute, Gram-negative, non-sporulating, gas-forming, obligate anaerobe, isolated in 35 cultures, and identified as *Micrococcus gazogenes* [Veillonella g.]. The cultural characteristics of the organism are presented. Although there was no indication of pathogenicity for rabbits, mice, or guinea pigs, the organism seemed to reduce the resistance of the animals to other microbes (i. e. Coccidia).

M. gazogenes was divided into two serological groups on the basis of the powerful agglutinins (all over 1:10,000) produced in 10 inoculated rabbits. Group A contained 22 strains; Group B, 2 strains. The presence of an immunological factor in man is suggested by the occurrence of a low grade agglutinating serum (1:40), the highest of which has been found in individuals free or almost free from gingival lesions.

Hallwachs, Wilhelm, 1910. ÜBER DEN PROPHYLAKTISCHEN NUTZEN DES GURGELNS [On the prophylactic value of gargling]. Zeitschr. f. Hyg. u. Infektionskrankh., 67: 373-386.

The prophylactic qualities of gargling were demonstrated in several experiments in which *B. prodigiosus* [*Serratia marcescens*] was artificially introduced into the oral cavity and throat of man and bacterial counts compared after one or more gargles (sterile physiological saline).

Hammond, Carolyn W., and Joseph P. Weinmann, 1942. OPSONIN IN SALIVA. Jour. dental Res., 21 (3): 279-283.

"The presence of a phagocytosis-stimulating factor in saliva was established by tests with the saliva of 41 patients selected at random. Proof of the identity of this factor as opsonin was secured by absorption and heating experiments. It was possible also to reactivate the heated saliva. In addition, it was found that there may be a factor in saliva which reduces the ability of serum to stimulate phagocytosis. The nature of this factor has not been determined." (Complete paper.)

Hammond, Carolyn W., and Joseph F. Weinmann, 1942a. OPSONIN IN THE SALIVA OF CARIES-NEGATIVE AND CARIES-POSITIVE PATIENTS. Jour. dental Res., 21 (6): 509-511.

"Thirty-five phagocytosis experiments were carried out using saliva from 18 caries-free individuals and 10 with rampant caries. The saliva from the caries-free persons stimulated 37 per cent of the leucocytes (average) to take up bacteria. Saliva from persons with rampant caries stimulated only 4 percent of the leucocytes (average) to take up bacteria. When both saliva and serum were used in the tests an inhibition of the opsonic action of the serum was noted. This inhibition was very slight when saliva from caries-free persons was used but was very marked when saliva from persons with rampant caries was used." (Author's summary.)

(Advance abstract: Jour. dental Res., 21 (3): 333-334. 1942.)

Hamburger, Morton, Jr., 1944. STUDIES ON THE TRANSMISSION OF HEMOLYTIC STREPTOCOCCUS INFECTIONS II. BETA HEMOLYTIC STREPTOCOCCI IN THE SALIVA OF

PERSONS WITH POSITIVE THROAT CULTURES. Jour. infect. Dis., 75 (1): 71-78.

A study was made of the hemolytic streptococcus content of 554 samples of saliva from 156 patients showing positive throat cultures. Numbers varied from none demonstrable to several million/cc. in heavily contaminated salivary samples. Over 80% of the samples from patients in the acute stages of the infection showed organisms of the same serological type as those found in the throat; hemolytic streptococci were not demonstrable in the remainder of such samples. A study of the bacterial counts in relation to time showed 51.4% of the patients to exhibit a gradual, or occasionally an abrupt drop in numbers of salivary hemolytic streptococci; the counts in salivary samples from 23.6% of the patients varied within wide limits from day to day; the remainder, one-half of which had no demonstrable hemolytic streptococci in their salivas, showed no change in count over the period of weeks of their hospital stay. No significant difference was found in salivary counts at various stages of scarlet fever as compared to pharyngitis-tonsillitis without rash. A tendency is noted for tonsillectomized patients to carry fewer salivary hemolytic streptococci and for a shorter period of time than patients with intact tonsils. The use of sulfonamide drugs caused no decrease in numbers of salivary or of throat hemolytic streptococci.

Hamburger, Morton, and O. H. Robertson, 1948. EXPULSION OF GROUP A HEMOLYTIC STREPTOCOCCI IN DROPLETS AND DROPLET NUCLEI BY SNEEZING, COUGHING AND TALKING. Amer. Jour. Med., 4 (5): 690-701.

The numbers of alpha (salivary), and beta (group A) hemolytic streptococci discharged into the air during sneezing, coughing, and talking were determined in a series of 48 men found to be carriers of group A streptococci (*Streptococcus pyogenes*). Use of blood agar plates exposed on the floor at varying distances from the subject, and of "broth bubbler" air samplers permitted differentiation of streptococci in rapidly falling droplets and those in droplet nuclei.

Quantitative culture of the saliva of the subjects showed the number of alpha streptococci per cc. to vary between 7,000,000 and 40,000,000 with an average of perhaps 20,000,000, beta streptococci varied between none and 2,000,000, with half the subjects having less than 500,000 per cc.

Results show saliva to be the principal medium expelled during a sneeze. Tests of several subjects showed the amount of saliva expelled to vary from less than 0.01 to 0.6 cc. Seven of 20 subjects sneezed out a large number of alpha streptococci as droplet nuclei; about 1/2 of the streptococci thus expelled were still present as long as 20 minutes after the first sneeze. Little or no saliva was found to be expelled during coughing or talking.

Hamill, Samuel McC., 1898. THE CONDITION OF THE SALIVARY DIGESTION IN ANEMIA. Philadelphia med. Jour., 1 (4): 156-159.

A study was made of the diastatic power of saliva of patients suffering from the following diseases: leukemia, chlorosis, exophthalmic goiter, pernicious anemia, and hemophilia; it is concluded that anemia does not cause any significant changes in the digestive ability of saliva.

A review is also given of previous literature concerning the diastatic power of saliva in various pathological conditions.

Hammarsten, Olof, 1888. UEBER DAS MUCIN DER SUBMAXILLARISDRÜSE [On the mucin of the submaxillary gland]. Hoppe-Zeyler's Zeitschr. f. physiol. Chem., 12 (1-2): 163-195.

Literature on the chemical constituents of mucin, and of the respective testing methods, is reviewed. A comparison of values obtained by the author with literature data failed to identify submaxillary mucin with the mucins from other sources.

Hammett, Frederick S., 1927. STUDIES OF THE THYROID APPARATUS. XLI. THE ROLE OF THE THYROID AND THE PARATHYROIDS IN THE GROWTH OF THE SUBMAXILLARY GLANDS. Amer. Jour. Anat., 39 (3): 463-475.

A report is made, of the effects of thyro-parathyroidectomy on the development of the submaxillary gland in the male and female albino rat, which includes a comparative discussion of the sexual differences encountered.

Thyroidectomy was found to retard the growth of the submaxillary glands at the various ages studied (23-100 days), the retardation effects being attributable to the resultant body conditions as a whole and not to any specific relationship of the submaxillary glands with the thyroid. Findings show that parathyroidectomy increases or accelerates glandular growth, and it is suggested that the growth changes are due to inhibition of neural regulatory mechanisms or to toxic influences resulting from parathyroid removal.

Gonadal changes are partially responsible for the submaxillary sensitivity to parathyroidectomy and, especially, to thyroidectomy.

Hanger, Franklin M., 1931. INFLUENCE OF SECRECTIONS OF THE UPPER RESPIRATORY TRACT ON TISSUE RESISTANCE. Proc. Soc. exper. Biol. Med., 29 (3): 285-286.

In approximately 40 experiments, the infectivity of *B. lepi-septicum* [*Pasteurella cuniculicida*] injected into the flank of rabbits was greatly enhanced by the introduction of human nasal secretions. Although the action of the secretions varied among individuals (and was apparently more active in individuals having colds), it consistently facilitated the spread of the infection, even in immune animals. Saliva exerted a similar action, but only to a moderate degree.

Hanke, Milton T., 1937. THE BUFFER VALUE OF THE SALIVA AND ITS RELATION TO DENTAL CARIES. Dent. Digest, 43 (5): 235-238, 252-256.

The relation of dental caries and the production of acid by oral bacteria to the salivary alkalinity was studied in immune, in non-susceptible (those with no caries developing in at least two years), and in susceptible individuals. Salivation was stimulated by chewing gum; 25 cc. samples were secured before and one hour after breakfast (mouth unrinsed and teeth unbrushed), and collected in sterile jars containing a germicide, parachlorometaxylenol. The hydrogen ion concentrations of portions of the salivary preparations were determined before and after the addition of delimited volumes of 0.1 N HCl.

In general, the saliva of the immune individuals remained slightly alkaline or neutral at all times; the addition of 1 cc. 0.1 N HCl to 10 cc. of saliva did not reduce the pH below 6.0, the post-breakfast samples being buffered to a greater extent than those taken before breakfast.

The pre-breakfast salivary samples of caries-susceptible persons were usually acid in character (pH 6.6) and with little capacity to neutralize acid; the addition of HCl depressed the hydrogen ion concentration to 4.4-5.6. Pre-breakfast samples had to be collected prior to 10 o'clock as samples collected after this time were neutral or alkaline even though nothing had been eaten; moreover, the salivary samples obtained before 8 A.M. were usually more acid and more poorly buffered than were later ones, and the ingestion of an early breakfast would not stimulate the secretion of a more highly buffered saliva.

The salivary buffering capacity of the non-susceptible group was similar to that found in the immunes except that the pre-breakfast samples were usually of pH 6.77 and could be reduced below 6.0 by HCl.

A further study was made of the rate of acid production from dextrose by oral bacteria and the effect of salivary buffers on the reaction. It was determined that the pre-breakfast samples of saliva developed a greater absolute acidity than did the post-meal sample, and that the immune group's saliva showed the greater amount of acid production. The post-breakfast salivary acidity was, however, approximately the same in all groups. Upon the addition of acid the salivary pH of the immune and non-susceptible groups remained rather high (5.8 to 6.8) while that of the susceptible group was reduced to 4.8-5.6, indicating their poor salivary buffering-capacity.

Hanke, Milton Theo., 1940. STUDIES ON THE LOCAL FACTORS IN DENTAL CARIES. I. DESTRUCTION OF PLAQUES AND RETARDATION OF BACTERIAL GROWTH IN THE ORAL CAVITY. Jour. Amer. dent. Assoc., 27 (9): 1379-1393.

A report is made of studies on the local factors affecting dental caries. The enamel partly neutralizes acids as it is dissolved in them and tends to maintain a pH between 5.6 and 4.2. Saliva regardless of source usually attains a pH of 4.2 to 4.4 when incubated for 6 hours in the presence of sugar. Methyl red determination of dental plaque acidity in the mouths of 12 persons showed a pH of 5 or below in six cases, a pH above 5 in five cases, and no plaques in one case. A similar test one hour after eating a cube of sugar showed all plaques to be pH 5 or below. Plaques are found to become acid in reaction where not bathed with saliva or where the saliva is poorly buffered and stagnant. Tests of proteolytic enzymes and fungicides on plaques shows these to be essentially living membranes.

In tests of various oral antiseptics, sweetened gum-stimulated samples of saliva (25 cc.) were collected before and 1, 2, 4, or 9 hours after holding 5-10 cc. of a test antiseptic in the mouth for 2 minutes without subsequent oral rinsing. One-half of the salivary sample was incubated 4 hours before electrometric determination of pH, the other half was sterilized and refrigerated then titrated with 0.1N HCl to the pH of the incubated sample to index its bacterial acid-production. Tests of 36 substances

as to their bactericidal efficiency and effect on mucous membranes for various periods of time are tabulated. Results are also tabulated of tests in 42 persons of a 1:5000 solution of sodium p-hydroxymercuribenzoate which was found most effective in removal of dental plaques, and inhibition of acid production (at a level dangerous to dental enamel) in incubated samples collected 4 or more hours after using the 1:5000 rinse. Arrest of dental caries and disappearance of gingivitis were noted in certain cases.

Hanke, Milton Theodore, 1940a. STUDIES ON THE LOCAL FACTORS IN DENTAL CARIES. Jour. Amer. dent. Assoc., 27 (12): 2005-2006.

A reply to Grossman (1940m).

Hansen, Harold L., Leonard S. Fosdick, and Charlotte F. Eppele, 1937. THE ACTION OF MOUTH ORGANISMS ON CERTAIN CARBOHYDRATES. Jour. Amer. dental Assoc., 24 (10): 1611-1617.

In vitro studies were made of the action of a number of common oral microbes on certain carbohydrates (soluble starch, wheat starch, dextrin, maltose), either in solid media or in combination with saliva. Methods and media are fully described.

On solid media, the organisms (B. aerogenes [Aerobacter a.], Saccharomyces cerevisiae, B. acidophilus [Lactobacillus a.], Staphylococcus aureus [Micrococcus pyogenes var. a.], Sarcina lutea, Staphylococcus albus [Micrococcus pyogenes var. a.]) exhibited only slight, if any, action on soluble starch; Bacillus subtilis and organism "No. 3" (a Gram-positive, spore-forming bacillus) which gave positive results.

In tests using either wheat starch, soluble starch, or dextrin in saliva medium, saccharification (measured in mg. glucose per 100 cc., for 120 hours) occurred to some extent with all organisms and ranged from 100 Staph. aureus) to 400 (with B. subtilis and with No. 3); it was 113 with A. aerogenes, and 266 with B. subtilis in combination with Saccharomyces cerevisiae. While B. Subtilis and No. 3 were most consistent in saccharification, the former produced no acid, and No. 3, which was less consistent, formed only slight amounts of acid. The greatest amount of acid (0.6 to 23.4 cc. as 0.1 N acid/100 cc., 120 hours) was produced by a combination of B. subtilis, L. acidophilus, and S. cerevisiae. With this combination, an inverse relationship occurred between the production of reducing sugar and that of acid.

The rate of decalcification by oral microbes was varied, S. cerevisiae, A. aerogenes, No. 3, and M. P. var. albus being the most active decalcifying organisms in order of decreasing activity. L. acidophilus alone was not effective, but in combination with either S. cerevisiae or A. aerogenes, enamel destruction was rapid and extensive.

Hanzlik, Paul J., 1910. THE EXCRETION OF HEXAMETHYLENAMINE IN THE SALIVA. Jour. Amer. med. Assoc., 54 (24): 1940.

The possibility that hexamethylenamine is excreted by human saliva, either free or as formaldehyde, was studied in two identical tests: An apparently healthy subject was given 0.6 or 0.3 g. hexamethylenamine in gelatin capsules per os and the saliva was collected over 60-75 minutes thereafter at 15 minute intervals. In both tests,

hexamethylenamine was excreted unchanged in the saliva, the greatest amount (as indicated by precipitation with bromine water) occurring during the first half hour. No free formaldehyde was found at any time, indicating the probable absence of any antiseptic value of the hexamethylenamine excretion.

Hargreaves, G. L., and R. S. Manly, 1953. DUPLICABILITY OF TESTS FOR RATE OF ACID PRODUCTION BY SALIVARY SEDIMENT. Jour. Dental Res., 32 (5): 651-652.

"When buffer, glucose, and hydrogen ion concentration and temperature are kept constant in a liquid that is in contact with sediment from whole stimulated saliva, the pH differential between the sediment and solution at equilibrium is an index of the rate of acid production by the sediment. Inhibitors of acid production can be evaluated from their effect on this differential with a control test. The duplicability of this index appeared satisfactory with repetitions of inhibitors either on the same sediment mass, on different sediments from the same subject, or on sediments from different subjects. Results were similar with four inhibitors when comparison was made between the sediments obtained by brushing the teeth with water and the sediments obtained from the whole salivas of the same subjects. Several inhibitors were studied which have been proposed at one time or another for control of dental caries. The pH differential was decreased by 0.01 percent sodium iodoacetate, 0.1 percent sodium fluoride, and 0.01 percent urea, but not by glyceraldehyde, naphthoquinone, or hydroquinone at these concentrations. No effect could be observed from treatment of a sediment with penicillin for several hours, even though the control differential from salivary sediment was diminished over one-half when saliva was collected twenty-four hours after brushing with penicillin dentifrice began." (Author's abstract)

Hargreaves, G. L., and R. S. Manly, 1956. PRECISION OF SALIVARY SEDIMENT TECHNIC FOR EVALUATING INHIBITORS. Jour. Dental Res., 35 (4): 591-595.

Determinations were made of the reproducibility of a method of measuring acid production by means of a thin layer of salivary sediment coated on a glass electrode (Manly, 1954). Tests were made using 0.01 M NaH_2PO_4 to double the buffer capacity of solution in contact with the salivary sediment. The average effects on different sediments ranged from 40 to 56%; the standard deviation was 11.4%. Tests were then made using 0.01% urea, to reduce sediment differentials approximately one half while the solution is in contact with the sediment. A high variance in test results was attributed to the susceptibility to urea shown by salivary sediments from salivas of 2 of the 6 test subjects. Tests of variance with an inhibitor (10 p.p.m. of sodium iodoacetate) showed 2 inhibitory effects: a 37% reduction (S.D. 4.5) in acid production rate while the chemical was in contact with the sediment, and a second residual effect showing 39% reduction (S.D. 4.3) during the recovery period after the treatment.

Duplicate tests by different operators, performing screening tests on 300 compounds, showed 57 of these reduced acid production during the

recovery period to 45% or less; the S. D. under test conditions was 7.6%. Tests comparing the effects of inhibitory agents on salivary sediments with those in saliva-glucose mixtures showed higher concentrations of such agents are necessary to inhibit acid formation in salivary sediment. Chemicals found effective by both methods, by saliva-glucose alone, and by neither method are tabulated.

Harkin, Alexander, 1888. SUPPRESSION OF THE SALIVARY SECRETION. *Lancet* (London), 1 (3362): 257.

A report is presented in which chlorate of potassium in water is suggested as a remedy for either suppressed salivation or for increased salivation. The salt is considered to act as a regulator of the gland.

Harris, Thomas, 1898. ON "DRY MOUTH" OR XEROSTOMIA. *Amer. Jour. med. Sci.*, 115 (3): 312-317.

Description is given of a case of xerostomia associated with enlargement of the parotid glands.

Harrison, R. W., Zdenka C. Zidek, and Elizabeth S. Hemmens, 1939m. SEROLOGICAL REACTIONS WITH CARBOHYDRATES DERIVED FROM ORAL LACTOBACILLI. *Jour. dental Res.*, 18 (3): 259.

"Fifteen strains of lactobacilli, isolated from saliva of patients with and without dental caries, have been utilized for production of antiserum by immunization of rabbits with whole cell suspensions and for extraction of bacterial carbohydrate. Of several methods used for carbohydrate extraction best results were obtained with a modification of the Porges method. Bacterial cells were suspended in N/16 HCl, boiled for 10 minutes, cooled, neutralized and centrifuged. Carbohydrate was obtained from the supernatant fluid by precipitation with 3 or 4 volumes of 95 percent alcohol, and was purified by repeated precipitations with alcohol or acetone. Precipitation tests between the various rabbit antisera and saline solutions of these 15 carbohydrates in dilutions of 1:1,000 to 1:1,000,000 have revealed 11 immunological types. Six of these are distinct and 5 show certain inter-relationships between 2 or more types. Carbohydrates similarly extracted from 85 strains of oral lactobacilli have been tested in the type antisera. About 60 percent of the strains have reacted specifically in the type sera and over 70 percent of these have fallen into 4 types. No correlation between morphological groups and immunological types has been found." (Complete paper.)

Harrison, R. W., and Zdenka Z. Opal, 1944. COMPARATIVE STUDIES ON LACTOBACILLI ISOLATED FROM THE MOUTH AND INTESTINE. *Jour. dental Res.*, 23 (1): 1-22.

"Lactobacilli were isolated from saliva and stool specimens from a series of patients [20 between the ages of 7-1/2 to 17] hospitalized in a children's hospital for various illnesses unrelated to dental conditions. Cultures were made at intervals over a period of about 6 weeks. At each examination period representatives of each recognizably different type of colony were chosen for subculture and further study. Independent clinical examination of the teeth was made before, during or after the period during which specimens were collected for culturing.

"No lactobacilli were found in the stool specimens from 5 children whose teeth were caries free. Lactobacilli were recovered only occasionally and then in small numbers from saliva samples obtained during the same study periods from these 5 children.

"Lactobacilli were found in 66% of the fecal specimens and 93% of the saliva samples from 11 individuals who had definite dental caries activity. There was a rough correlation between the number of lactobacilli in the saliva and the frequency of successful isolation of these organisms from the stools.

"Approximately 100 cultures obtained from saliva and stool samples provided by 11 of the patients were maintained in laboratory culture media over a period of 16 to 22 months during which time repeated observations were made on gross and microscopic morphology, fermentation capacity and immunological reaction. None of the strains in either the oral or intestinal group exhibited characteristics not found among strains in the other group. Although there were some differences in the proportions of various colony types and fermentation groups at the time of isolation these differences disappeared after a period of laboratory cultivation. More than half of the cultures were tested immunologically in type specific antisera and the same types were found in about the same proportions in the two groups.

"Paired, oral and intestinal cultures from 8 individuals, studied comparatively, were found to be identical in morphology, fermentative action and immunological reaction.

"It is concluded that the cultures isolated from the intestine had their origin in the mouth and that the supply of these organisms is continually replenished by the swallowing of lactobacillus-contaminated saliva. The relationship of the oral lactobacillus with the intestinal Lactobacillus acidophilus is discussed." (Authors' summary.)

Harte, Robert A., 1947. SUBSTANCES IN HUMAN SALIVA FROM "NON-SECRETORS". *Jour. biol. Chem.*, 167 (3): 873.

A substance was isolated from saliva of group A "non-secretors" (according to Landsteiner et al., 1941: "individuals whose secretions do not contain the serological active substance"). The non-secretor substance had physical and chemical properties similar to those previously recorded for the substances from secretors, but was inactive when tested for its capacity to inhibit isoagglutination. In the chemical analysis, the non-secretor substance contained 5.00% N, 2.46% amino-acid N, 1.65% hexosamine N, 44.2% reducing sugars (as glucose), 21.3% hexosamine, and 1.40% ash.

It is pointed out that all these saliva substances react strongly with antipneumococcus XIV horse serum in the cold, the A non-secretor substance perhaps in higher dilution than the others.

Hartles, R. L., and Norma D. McDonald, 1950. THE METABOLISM OF THE ORAL FLORA. I. THE OXYGEN UPTAKE AND ACID PRODUCTION BY MIXED HUMAN SALIVA IN THE PRESENCE AND ABSENCE OF GLUCOSE. *Biochem. Jour.*, 47 (1): 60-64.

The oxygen consumption and lactic acid production of saliva from nine human subjects (male and female) were measured with a Warburg manometer and the Barker-Summerson methods, respectively,

in an attempt to correlate these processes with the presence, absence, or quantity of dental caries. In the absence of glucose in the salivary samples, no detectable traces of lactic acid were found; the O_2 consumption increased, with a slightly greater uptake occurring in those saliva taken from mouths containing the most caries.

Data suggests that both anaerobic and aerobic processes occur in saliva and that the lactic acid production, in the presence of glucose, is greatest under oxygenless conditions. It is concluded that a high salivary lactic acid content is not associated with the number of dental caries, nor is there any significant relationship between the extent of dental caries and O_2 consumption.

Hartles, R. L., and M. R. Wasdell, 1954. THE FRUCTOFURANOSIDASE (INVERTASE) ACTIVITY OF WHOLE SALIVA. *Jour. Dental Res.*, 33 (5): 729.

Metabolic measurement of the effects of different glycosides on whole saliva, as well as enzyme analysis of fractionated saliva, have shown sucrose and raffinose, but not melibiose, to be metabolized by the oral flora. Whole saliva thus appears to contain a beta-fructofuranosidase.

A strain of lactobacillus under study shows rapid acid production with glucose and some other monosaccharides, but not raffinose or maltose. Addition of sterile, Seitz-filtered saliva to washed suspensions of this bacillus did not enhance acid production from sucrose or raffinose; similar saliva, with invertase added, did. It is suggested that certain salivary microorganisms possess an intracellular beta-fructofuranosidase which is absent from salivary secretions. (From author's abstract)

Hartles, R. L., and M. R. Wasdell, 1955. A COMPARISON OF THE METABOLIC ACTIVITY OF SALIVARY SEDIMENT WITH THAT OF WHOLE SALIVA. *Jour. Dental Res.*, 34 (5): 784.

An investigation was made of the relationship between the metabolic activity of the sediment of centrifuged saliva and its containing fluid. Washed suspensions of salivary solids were found to have a much reduced metabolic activity; addition of salivary supernatant fluid to the suspension restores activity. While intrinsic activity of saliva rests in its solids, the fluid portion contains an adjuvant without which metabolic processes are greatly retarded. (From author's abstract)

Hartles, R. L., 1956. OBSERVATIONS ON THE INHIBITION OF SALIVARY GLYCOLYSIS. *Jour. dent. Res.*, 35 (6): 966.

Manometric methods were used to determine the effect of 4 inhibitors on salivary glycolysis. The substances were sodium ricinoleate (I), sodium lauryl sulphate (II), sodium N-lauryl sarcosinate (III), and sodium potassium copper chlorophyllin (IV). All were added in a concentration of 67 ppm. The effect on glycolysis was observed first, when the inhibitor was added to the saliva before the addition of glucose, and secondly, when added after the addition of the sugar. The percentage inhibitions were as follows: (I) 57, 11; (II) 75, 18; (III) 10, 0; (IV) 76, 77. With the exception of IV the inhibition of glycolysis was much less when the inhibitor was added after the glucose. In a sample of whole saliva, therefore, a given concentration of inhibitors, I, II, or III

is more effective when added before the substrate than when added to the actively glycolysing saliva. In IV the degrees of inhibition is unchanged. (Author's abstract)

Hartmann, G., 1939. SUR LE FERMENT ANTI-GROUPES DANS LES GLANDES SALIVAIRES ET DANS LA SALIVE CHEZ L'HOMME [On the anti-group enzyme in the salivary glands and in the saliva of man]. *Comp. rend. Soc. Biol. (Paris)*, 131: 254-258.

The role of body enzymes in the spontaneous destruction of group antigen in the saliva was studied, using sterile submaxillary gland tissue from non-infected cadavers (accidental death cases). Two grams of such tissue was placed in 2 cc. of sterile saliva (dilutions of 2^{-2} to 2^{-11}) from group A and group B donors; the saliva was then titrated at 24- to 48- hour intervals for its inhibitory effect in a dilute iso-serum. A portion of the tissue was also placed in cysteine agar medium under similar experimental conditions as a sterile control. Tests, using tissue from four different glands, showed a slow drop in titer during the first 4 to 5 days before resting at a constant level. Similar tests of such tissue, extirpated with non-sterile technique, showed complete destruction of the antigen in the saliva control to occur in 24 to 48 hours. Bacterial growth was noted in cysteine agar containing the non-sterile tissue after 24 hours; seeding of salivary samples with culture from the agar caused destruction of the salivary group antigen after about 48 hours. Further test showed 7 of 10 anaerobic bacterial cultures [*Clostridium* sp.] to produce complete destruction of the salivary antigen. Bacterial destruction of the antigen is more rapid and complete than that produced by body enzymes. The enzyme was found present in glandular tissue from both "excretors" and "non excretors".

Hartsell, S. E., 1947. THE NEWER KNOWLEDGE OF LYSOZYME AND BACTERIA. *Proc. Indiana Acad. Sci.*, 57: 44-53.

An extensive review of the literature pertaining to lysozyme is presented, in which it is mentioned that this basic polypeptide occurs in saliva, as well as in other natural fluids; that salivary lysozyme does not give cross-precipitin reactions although it possesses the ability to lyse insensitive bacteria.

Hartzell, Thomas B., 1923. SHOWING THE POSSIBILITIES OF STARCH DIGESTION IN THE MOUTH. *Jour. Amer. dental Assoc.*, 10 (1): 68-71.

The digestion of starches by saliva, in particular the significance of chewing, was studied. When 4.5 g. of white bread were chewed for 1 minute (5.9 g. saliva), and then removed and examined, 12% of the starch was digested; after 2 minutes, 22%; after 5 minutes, 50%; and after 12 minutes, 80%. When only 4.0 g. of bread were combined with 2.5 g. saliva and chewed for only 1/2 minute, in 15 minutes after removal only 40% was digested. When a "large bite" of sode cracker (2.97 g.), not salted, was chewed for 1/2 minute (3.0 g. saliva), the amount of saliva was inadequate for extensive digestion. After 18 minutes standing, 5.1 g. saliva were added and digestion took place rapidly. When 1.0 was chewed for 2 minutes and retained in the mouth for an additional 3 minutes (adding 9.1 g. saliva), 30% of

the total digestion had occurred after 6 minutes. When 1.14 g. of cracker was chewed for 1 minute (7.9 g. saliva), 75% of the total starch was digested in 4-1/2 minutes and 86% in 10 minutes. Similar results were obtained with whole wheat cracker and with cold boiled potato.

When a corn starch paste was held in the mouth for various periods of time, results were as follows: after addition of 20 g. saliva to 25 cc. of a 4% corn starch paste containing .85 g. cornstarch, 70% of the total starch was digested within 2 minutes. When 1 g. raw cornstarch was acted upon by 9.0 g. saliva, only about 4% of the starch had been digested at the end of 2 minutes.

Hatton, Edward H., 1934. PRELIMINARY REPORT CONCERNING ALTERATIONS IN THE BLOOD AND THE SALIVA. Jour. Amer. dental Assoc., 11 (12): 1166-1167; discussion, p. 1167-1169.

A note on the alterations in chemical composition of saliva and blood in health and in disease. No experimental data.

Hatton, Edward H., 1942. EFFECT OF CHEWING PARAFFIN AND GUM AFTER MEALS ON SALIVARY ACIDOPHILUS COUNTS. Jour. dental Res., 21 (3): 334.

Two sets of experiments on 19 students each showed that the chewing of either paraffin or gum after meals noticeably reduced the salivary *Lactobacillus acidophilus* counts. In one experiment, the students chewed a stick of soft paraffin for 10 to 15 minutes three times daily (immediately after each meal). The counts taken during these periods averaged 34.5% of the control counts (unstimulated saliva taken under similar conditions). A repetition of the test with chewing gum showed the average acidophilus counts to be 67.5% of the control counts.

It is thereby seen that the chewing of paraffin or gum after meals effects a reduction in salivary acidophilus counts, the reduction by paraffin chewing being considerably greater than that by gum.

Hawkins, Harold F., 1929. DENTAL DECAY--WHAT IT IS AND MEANS FOR ITS CONTROL. Jour. Amer. dental Assoc., 16 (5): 781-795.

A study of the oral environment during dental decay indicated that a pH of 6.0 or less is necessary for tooth decalcification. "Several thousand salivary tests" indicated that no mouths had a greater natural acidity than 6.0 pH. Because the pH of carbohydrates was found to be 4.5 to 3.3, it is concluded that the prime factor in dental decay is a dietary one. An examination of carbohydrates led the author to attribute the decalcifying activity to cereal grain, specifically to the class of starches containing gluten which is insoluble in saliva and causes fermenting starch to adhere to the teeth. The decalcifying process may be neutralized by the saliva if it is sufficiently alkaline, due to the presence of alkaline salts and/or calcium.

Hawkins, Harold F., 1931. WHAT IS THE CAUSE OF CARIES AND SYSTEMIC PYORRHEA? Jour. Amer. dental Assoc., 18 (5): 943-945.

The author states that caries and pyorrhea are the result of a disturbed metabolism and that infection is not the primary cause of either caries or pyorrhea.

In simultaneous saliva, blood, and urine tests on the calcium and phosphorus balance of pyorrhea patients, it was found that the salivary balance is the opposite of that of the blood. When blood calcium is high, salivary calcium is low; when blood phosphorus is low, salivary phosphorus is high. The calcium and phosphorus level of the urine was observed to parallel that of the blood.

A diet high in calcium, strongly alkaline, and moderate in vitamin D is suggested in the treatment of pyorrheal conditions.

Hawkins, Harold F., 1931a. A RATIONAL TECHNIQUE FOR THE CONTROL OF CARIES AND SYSTEMIC PYORRHEA. Jour. dental Res., 11 (2): 201-219; discussion, p. 220-234.

A correlation was observed between a faulty balance of calcium and phosphorus contents in the blood on one hand and the presence of caries and of systemic pyorrhea, on the other.

In pyorrhea, the blood was low in calcium and high in phosphorus; in caries, the condition was reversed. The excessive phosphates in pyorrhea were deficient in dibasic salts. The saliva was usually moderately acid to neutral, with excessive calcium content.

A controlled diet is suggested as a correction of such conditions; the author suggests a diet high in calcium and with more dibasic and less monobasic phosphates.

Hawkins, Harold F., 1932. MANIPULATION OF FOOD IN THE CONTROL OF DENTAL CARIES AND SYSTEMIC PYORRHEA. Jour. Amer. dental Assoc., 19 (6): 963-966.

The author claims that proper manipulation of diet can eliminate all possibilities of dental decay and systemic pyorrhea. It was shown that (1) vegetables, potatoes, and fruit decreased the pH and the calcium and phosphorus contents of saliva; (2) meat, fish, eggs, American cheese, and vitamin D increased the salivary pH, calcium and phosphorus; (3) butter, cream, fats, and oils increased all three; (4) cereals or grain foods increased salivary pH and phosphorus content but decreased the calcium; and (5) milk decreased pH and phosphorus and increased the calcium content.

Hayden, C. E., 1918. OROKINASE AND PTYALIN IN THE SALIVA OF THE HORSE. Amer. Jour. Physiol., 45 (4): 461-470.

A comparative study of human and horse salivary secretions revealed that the mixed and parotid secretions from horses do not possess an appreciable ability for digesting solutions of either ground corn or oats. However, the mixed saliva has a slight potency for digesting cooked starch over a period of 24 hours. Human salivas, on the other hand, when in the same proportions as the equine test-salivas, readily acts upon cooked starch, and is able to hydrolyze corn and oats into appreciable quantities of sugar.

Parotid horse-saliva or salivary gland extracts were not activated by extracts of equine oral mucosa, buccal glands, or salivary glands, by human saliva, or by mixed equine saliva.

Haydon, Glen B., J. W. Hein, and D. E. Gardner, 1951. PRELIMINARY INVESTIGATIONS OF THE EFFECT OF SODIUM MONOFLUORO-PHOSPHATE ON SALIVARY ACID PRODUCTION AND HYDROXY APATITE SOLUBILITY. Jour. Dental Res., 30 (4): 466.

"In the present investigation it was found that fluoride as Na_2FPO_3 was approximately twice as effective as fluoride as NaF in inhibiting acid production in saliva-glucose mixtures. It was also shown that while increasing amounts of calcium ions progressively decreased the effectiveness of NaF against salivary acid production, no such decrease was observed for Na_2FPO_3 . While the calcium salt of H_2FPO_3 is soluble to the extent of 1 gm. in 100 ml. of water, it was found, however, that Na_2FPO_3 decreased the solubility of hydroxy apatite. Samples of hydroxy apatite were treated with Na_2FPO_3 and NaF at levels of 20, 40, 80, 160, and 320 ppm fluoride. The apatite treated with Na_2FPO_3 at the lower levels of fluoride showed a greater solubility than that treated with NaF . At the higher levels of fluoride the situation was reversed. Fluorine analyses of NaF -treated apatite increased at each successive level. The fluorine content of Na_2FPO_3 -treated apatite was always below the NaF , being about 1/2 at the 80 ppm level." (Authors' abstract)

Hays, Harold M., 1904. A HISTORY OF SALIVA, ITS PHYSIOLOGY, CHEMISTRY, AND PATHOLOGY. Medical News (N.Y.), 84 (13): 582-587.

A comprehensive discussive-review is presented on the historical, physiological, and pathological aspects of saliva.

Hazard, René, and L. J. Mercier, 1925. ACTION DE LA BASE TROPINE SUR LA SÉCRÉTION DE LA GLANDE SOUS-MAXILLAIRE [The effect of the tropine base on the secretion of the submaxillary gland]. Compt. rend. de la Soc. de Biol. (Paris), 93 (26): 518-520.

Successive administration of weak injections of the alkaloid tropine (0.01 - 0.02 g. per kg.) in chloralosed dogs caused a drop in submaxillary saliva flow with each dose in response to identical electrical stimulation of the chorda tympani. Multiple or strong doses caused cessation of salivation which gradually resumed as the tropine was broken down or eliminated by the system. Injections of adrenaline hydrochloride had no effect on the arrest or renewal of salivation when administered before, during, or after the injections to tropine. Tropine is considered to act on the secretory terminals of the chorda tympani in the submaxillary gland.

Hazard, René, 1926. ACTION DE LA PSEUDOPelletierine SUR LA SÉCRÉTION DE LA GLANDE SOUS-MAXILLAIRE [The effect of pseudopelletierine on submaxillary gland secretion]. Compt. rend. de la Soc. de Biol. (Paris), 95 (22): 184-185.

The effects of pseudopelletierine on submaxillary gland salivation of dogs under chloralose anesthesia was studied. Salivation was measured during 30-second periods of electrical stimulation of the chorda tympani before and after intravenous injection of the alkaloid. A dose of 0.01-0.02 g./kg. body weight caused a slight drop in flow (which could be returned to normal by a slight increase in stimulus intensity); a notable drop in flow followed a 0.04-0.05 g. dose, while a 0.05-0.10 g. dose caused complete cessation of flow.

Hazard, René, 1929. RECHERCHES SUR L'ANTAGONISME DE LA BASE TROPINE (TROSPANOL) ET DE LA

PILOCARPINE SUR LA GLANDE SOUS-MAXILLAIRE [Studies on the antagonism of the base tropine (Tropanol) and of pilocarpine on the submaxillary gland]. Compt. rend. Soc. biol. (Paris), 102: 574-576.

A regular, constant flow of saliva was stimulated in the dog by a slow, continuous injection of a dilute solution of pilocarpine nitrate into the saphenous vein. After establishment of such salivation, usually attained by injection of .1 to .25 mg. of pilocarpine, an injection of .1 g. of tropanol causes an abrupt cessation of salivation which gradually resumes as a result of the continued injection of pilocarpine. A second injection of tropanol causes a similar temporary diminution in salivation. Tropanol is considered to inhibit the secretory effect of pilocarpine on the secretory nerve terminals.

Hazard, Rene, and L. Wurmser, 1933. ACTIONS COMPAREES DE LA NICOTINE ET DE LA SPARTEINE SUR LA SECRETION DE LA GLANDE SOUS-MAXILLAIRE [Comparative actions of nicotine and sparteine on the secretion of the submaxillary gland]. Compt. rend. Soc. Biol. (Paris), 114: 1240-1242.

The effects of intravenous injection of nicotine and of sparteine were studied in the dog which was receiving artificial respiration and continuous injection of pilocarpine. Injection of 5 to 20 mg. of nicotine/kg. caused a short initial phase of hypersecretion which was followed by a temporary, partial cessation of the submaxillary flow established by the pilocarpine. The pilocarpine rapidly overcomes the effect of the nicotine with the reestablished flow exceeding the original level. A second similar injection of nicotine evokes a new drop in flow, similar to that produced by the original injection.

Injection of sparteine in the dog under similar conditions likewise causes a diminution in salivation but without an initial hypersecretion. The depressed flow produced by sparteine (occasionally by a 0.01 g./kg. dose; constantly by a 0.02 g./kg. injection) is restored, but more slowly than after nicotine, to about its original level by pilocarpine.

Both nicotine and sparteine are considered to affect the chorda tympani, paralyzing neither the terminal fibers nor the secretory cells of the submaxillary gland.

Hazard, René, and Elisabeth Corteggiani, 1946. UN NOUVEL EXEMPLE DE L'ACTION PARASYMPATHOLYTIQUE DE LA NOVACAINE; SON ACTION D'ARRÊT SUR LA SÉCRÉTION SALIVAIRE [A new example of the parasympatholytic effect of novacaine: its inhibitory effect on salivary secretion]. Compt. rend. de la Soc. de Biol. (Paris), 140 (3-4): 128-129.

The submaxillary gland of chloralosed dogs was stimulated to a constant flow either by electrically exciting the chorda tympani or by a continuous intravenous injection of pilocarpine. Administration of novocaine (0.05 g./kg of body weight, injected slowly to avoid a sudden drop in arterial pressure) during chorda stimulation caused a temporary drop in submaxillary saliva flow to 1/3 or 1/4 of the normal rate. Novocaine injected slowly (0.02 - 0.05 g./kg) during pilocarpine stimulation caused an immediate drop in saliva flow which returned to the normal rate 20-50 minutes later. The authors consider novocaine to have an inhibitory effect on the parasympathetic nervous system.

Head, Joseph, 1907. DR. MILLER'S OBSERVATIONS ON THE WASTING OF TOOTH TISSUE, VARIOUSLY DESIGNATED AS EROSION, ETC., VIEWED IN THEIR RELATION TO THE POWER POSSED BY SALIVA OF CONTROLLING ACID DECALCIFICATION. *Dental Cosmos*, 49 (8): 801-807.

The enamel of a tooth exposed to CO₂ in saliva, with a few drops of chloroform added, was not decalcified after thirty days in the solution at 98°F. The tooth, washed and placed in an aqueous solution of CO₂, was badly decalcified after 24 hours. Saliva was found to have an inhibitory effect on other acids; a 1:500 solution of lactic acid (but not a 1% solution of the acid) tested for 15 days and a 1:6 solution of lemon juice tested for 2 days. Saliva also showed some inhibitory effect on decalcification due to strawberry juice, sodium phosphate, and acid sodium phosphate. The enamel cuticle protected the enamel to some extent.

Head, Joseph, 1912. A STUDY OF SALIVA AND ITS ACTION ON TOOTH ENAMEL IN REFERENCE TO ITS HARDENING AND SOFTENING. *Jour. Amer. med. Assoc.*, 59 (24): 2118-2122.

The protective action of saliva against destruction of dental enamel by various acids (natural or introduced by such foods as citrus fruits) is discussed.

Hebb, Catherine O., and George W. Stavraky, 1936. THE PRESENCE OF GLUCOSE IN THE SALIVARY SECRETION AFTER THE ADMINISTRATION OF ADRENALIN. *Quart. Jour. exper. Physiol.*, 26 (2): 141-153.

"1. In cats anaesthetized with nembutal the saliva secreted by the submaxillary gland in response to stimulation of the chorda tympani or the cervical sympathetic nerve is free from glucose, unless the blood sugar concentration is higher than 400 mg. percent.

"2. After intravenous administration of adrenalin a considerable amount of glucose may be detected in the saliva; the larger the dose of adrenalin, the greater will be the glucose content. If the adrenalin injections are discontinued, the glucose gradually decreases until there is no trace of it in the saliva.

"3. The presence of the sugar in the saliva after adrenalin administration is due to the action of the adrenalin on the gland itself and not to the hyperglycaemia produced by the adrenalin. However, if under these conditions the blood sugar concentration is raised by the injection of glucose, a larger amount of glucose is detectable in the saliva.

"4. It is concluded that adrenalin renders the salivary glands permeable to the glucose present in the blood." (Authors' summary and conclusions.)

Hecht, Hans, 1909. A CONTRIBUTION TO THE PROPHYLACTIC TREATMENT OF CARIES. *Dental Cosmos*, 51 (11): 1275-1279.

Tablets containing malt diastase, malt, and potassium thiocyanate were administered to 10 persons who had previously shown absence of potassium thiocyanate in the saliva. Analyses of saliva by means of a ferric chloride test up to 4 months after ingestion of the tablets showed presence of the potassium thiocyanate in the saliva.

Hecker, I. W., 1933. KONZENTRATION DER WASSERSTOFFIONEN IN SPEICHEL DER ÄTZER [The

hydrogen ion concentration in the saliva of the etcher]. *Arch. Hyg. und Bakteriologie*, 111 (5): 255-262.

Work in the etching section of a sheetmetal plant, contributed to the development of pathological condition in the oral mucosa of certain workers, although the incidence of dental caries was not greater in etchers than in other workers of the plant. This is attributed to the buffer properties of the saliva which prevent the fumes of sulphuric acid from decomposing dental calcium. When salivary pH was determined outside the etching section, the alkalinity of the saliva was evident in each case. Saliva stimulated by various foods (lemon, biscuit, and candy) and collected from the oral cavity was slightly acidic, while saliva obtained from the parotid duct by a siphon showed an alkaline reaction.

Hecker, I. W., 1933a. DIE VISCOSITÄT DES SPEICHEL BEI ARBEITERN, WELCHE DIE ÖFEN DER WERKE ZU BEDIENEN HABEN [Viscosity of the saliva in workmen tending the furnaces in industrial plants]. *Arch. Hyg. und Bakteriologie*, 111 (5): 263-270.

The viscosity of the saliva of workers exposed to high temperature furnaces was determined. Saliva samples were collected by siphon from the duct, by expectoration, and by pipette from the oral cavity. At the environmental temperature of 60°R. (564°F.) a high viscosity rate (28"-102"-126") was seen in certain cases, while in other workers it was considerably weaker (5"-13"-18"-22"). The salivary viscosity returned to normal after a rest period or after washing up after work. Ingestion of boiled drinking water decreased salivary viscosity only very slightly. However, carbonated water given to furnace workers to compensate for the loss of chlorides, increased salivary viscosity two to three fold, as compared to the drinking of a 1/2% sodium chloride solution which had little effect on the fluctuation of viscosity. Salivary viscosity increased when warm air was only inhaled and the whole body was not affected by high environmental temperature. With regard to the contribution of the various salivary glands to the degree of viscosity, it was ascertained that while parotid saliva showed no change, the viscosity of the submaxillary saliva increased under the effect of temperature. The contribution of the smaller mucous glands to the increase in viscosity is important. The amount of organic salivary substances increases, and that of the inorganic substances decreases under the impact of high temperature; the viscosity of the saliva collected from the oral cavity is much higher than that collected directly from the submaxillary gland. This is an indication of the contribution of the smaller glands located in the oral cavity.

Hegemann, Ferdinand, 1942. NEUE VERSUCHE ZUR KLÄRUNG DER KEIMSCHÄDIGENDEN WIRKUNG DES MENSCHLICHEN SPEICHEL [Recent tests for the explanation of the antimicrobial action of human saliva]. *Zeitschr. f. Hyg. u. Infektionskrankh.*, 124 (2): 202-210.

From literature data and from personal experiments, the author concludes the following: Fresh saliva contains a thermolabile, non-filterable (asbestos), antibacterial agent whose action is effective through cellophane (*in vitro* culture studies). Its efficacy is dependent upon the

antagonistic action of salivary streptococci constant inhabitants of the oral flora; this agent is destroyed by the same chemical and physical agents which destroy the streptococci. Addition of these organisms to inactivated saliva produces a reactivation. Introduction of the streptococci to bouillon cultures of oral microbes does not affect their activity. The inhibitory activity of antagonistic streptococci is exerted against the same microorganisms as are affected by fresh saliva.

Hegemann, F., 1943. NEUE VERSUCHE ZUR KLÄRUNG DER KEIMSCHÄDIGENDEN WIRKUNG DES MENSCHLICHEN SPEICHEL [New tests for the elucidation of the antibacterial effect of human saliva]. Zeitschr. f. Hyg. und Infektionskrankh., 124: 202-210.

The antibacterial factor in saliva, termed inhibine (Dold 1936m; 1937mm; 1942mm), is attributed to the presence in saliva of green-staining [alpha hemolytic] streptococci. Prolonged testing of fresh salivas has shown their constant presence. Heating fresh saliva at 56°C for 30 minutes killed the cocci and destroyed the inhibiting effect of the saliva, while cooling at -4°C for 4 days did neither. The bacterial inhibitory action of saliva was removed on filtration through an asbestos filter. Saliva, from which a pure culture of the streptococci antagonistic to *Staphylococcus pyogenes aureus* [*Micrococcus pyogenes* var. a] had been obtained prior to such filtration, could be reactivated by addition of a portion of the pure culture. Culture tests with the total salivary flora showed the inhibitory effect of the streptococci to remain in the presence of the accompanying flora; the active principle was also found to diffuse through cellophane. The streptococci were found to be antagonistic to the same species Dold had tested against fresh saliva; the strongest activity was observed against vibrios, and the weakest against Gram-negative rods, especially *B. coli* [*Escherichia coli*].

Hegemann, F., 1950. ÜBER EINEN VON MENSCHLICHEN SPEICHELKOKKEN ERZEUGTEN ANTIBIOTISCHEN STOFF [An antibiotic substance produced by the salivary cocci of man]. Zeitschr. f. Hyg., 131: 241-258.

An earlier study of the antibacterial action of salivary streptococci is continued. A drop of either fresh human saliva or of a pure culture of the alpha hemolytic streptococci produced a zone of inhibited growth on an agar plate culture of *Staphylococcus aureus* [*Micrococcus pyogenes* var. aureus] after 24 hours of incubation. Small quantities of *S. aureus* did not survive 24 hours incubation in a mature bouillon culture of the salivary streptococci. Separation of the antibacterial principle in weakened form was effected by heating the streptococci at 56°C for 45 minutes and by prolonged standing of the streptococcus culture at room temperature to kill the bacteria and leave the principle. The active principle was also obtained by dialyses through cellophane or by filtration through a rubber-like membrane. The antibiotic principle is destroyed by heat at 100°C.

Heidensleben, L., and N. C. Turner, 1958. THE GLYOXYLIC REACTANT IN SALIVA. Jour. dent. Res., 37 (5): 788-797.

Modification of a glyoxylic-sulfuric test for tryptophane is described as used in the analysis

of the supernatant of centrifuged saliva from 192 subjects, aged 4 to 15 years. Spectrophotometric reading at 570 mμ, of the optical density developed by the salivary samples, showed a tendency for smaller amounts of the glyoxylic reactant in the saliva of the subjects showing the most extensive decay and larger amounts in the saliva of the caries-free subjects. The glyoxylic reactant levels read at 570 mμ were not, however, systematically related to varying degrees of dental caries experience. Description and test results are given of a comparative spectrophotometric analysis of the glyoxylic reaction products of salivas from 16 subjects and of tryptophane and other indole-containing substances. Results show a good spectrophotometric estimation of tryptophane and tryptamine at 570 mμ; interpretation is complicated by interference from other molecules in the test mixtures.

Hein, John W., 1954. A STUDY OF THE EFFECT OF FREQUENCY OF TOOTH BRUSHING ON ORAL HEALTH. Jour. Dental Res., 33 (5): 708.

A study of the frequency of tooth brushing, correlated to findings from oral clinical examinations and salivary analyses, showed such brushing once or twice a day in 60 males, 21 to 28 years old, to have no apparent effect on gingival hyperemia, edema, proliferation, on bleeding dental caries, lactobacilli, original pH of saliva or the pH after 3 hours of incubation. In a group of 92 females brushing 2, 3, 4, or more times per day, increased frequency of brushing was followed by a marked progressive decrease in gingival hyperemia, edema and bleeding, lactobacilli, gingival debris, stains, salivary odor, and salivary debris. Little difference was found between groups as to salivary acid production. Somewhat similar results were obtained in a study of 155 males brushing 1, 2, 3, and 4 times per day.

Hein, John W., J. F. Bonner, F. Brudevold, F. A. Smith, and H. C. Hodge, 1956. DISTRIBUTION IN THE SOFT TISSUE OF THE RAT OF RADIOACTIVE FLUORIDE ADMINISTERED AS SODIUM FLUORIDE. Nature, 178 (4545): 1295-1296.

A report is made of preliminary experiments in which rats were given radiofluorine. At 10, 30, and 90-minute intervals after administration of the radioactive fluorine, the rats were killed by ether anesthesia, and analysis made of soft tissues. Results showed an increased concentration of the fluoride in the parotid gland after 90 minutes, indicating these glands to be sites of fluorine secretion.

Hellauer, H., and M. Schneider, 1940. ÜBER DIE GEWINNUNG EINES VERDÜNNUNGS- UND EINES GLEITSPEICHEL DURECH ALLEINIGE REIZUNG DER CHORDA TYMPANI ALS BEISPIEL SELEKTIVER ERREGUNG VEGETATIVER NERVEN [On the production of dilution- and lubrication saliva by the exclusive stimulation of the chorda tympani as an example of selective excitation of autonomic nerves]. Pflüger's Arch. ges. Physiol., 244 (2): 292-308.

The lingual nerves of anesthetized dogs were cut. A glass tube was inserted into the Bartholin duct and an electrode placed in the exposed chorda tympani. The frequency of stimulation during the individual experiments was 1.2-3 per second and each stimulation lasted from 10 seconds to 5

minutes yielding an average 1.5 cc. saliva. The samples were analyzed for their protein and salt content. Results have indicated that increase in salt concentration was linear with the speed of secretion. The protein content of the saliva did not depend on the speed of secretion; the increase of stimulation, however, increased the protein concentration. Further, it was possible to modify the protein content by selected stimulation of the nerve fibers of the chorda by changing the position of the electrode or the time of the stimulation. It is concluded that the chorda tympani is not a homogenous nerve but it consists of nerve fibers performing various functions. When the individual fibers were exposed to stimulations of a specific intensity, saliva of corresponding composition was obtained.

Helman, Edith Zak, and D. F. Mitchell, 1953. LACTOBACILLI AND DENTAL CARIES IN THE HAMSTER. Jour. dent. Res., 32 (5): 596-600.

A study was made of adult hamsters and their offspring, who had been fed 3 different kinds of diets, to determine if there was a correlation between Lactobacillus acidophilus counts and caries activity. In the adult hamsters no such correlation was found. However, a significant association was noted between lactobacillus counts and coliform counts. In the offspring of the adult hamsters, a correlation between caries and L. acidophilus counts was noted one month prior to sacrifice but not at the time of sacrifice. It is suggested that the true significance of these lactobacillus counts may be affected by contamination with fecal lactobacilli.

Helman, Edith Z., and D. F. Mitchell, 1954. PHOSPHATASE IN HUMAN SALIVA: ITS RELATIONSHIP TO CALCULUS AND LACTOBACILLUS COUNTS. Jour. Dental Res., 33 (3): 335-338.

Determination of phosphatase levels and lactobacillus counts were made in paraffin-stimulated salivas of 49 dental students, 24 of whom had a history of recurrent calculus; the remainder being relatively free of calculus. Salivary phosphatase determination, by means of a phenyl dihydrogen phosphate disodium salt with citrate and with bicarbonate buffers, showed the presence of only an acid phosphatase having optimum activity at pH 5.5; no significant difference in levels were found with respect to recurrent calculus, a mean of 0.840 ± 0.097 for students with calculus, and a mean of 1.014 ± 0.122 for those free of calculus. The mean lactobacillus counts for the two groups also lacked significant difference. No association between phosphatase levels and lactobacillus counts was found.

Hemmens, Elizabeth S., J. R. Blayney, and R. W. Harrison, 1941. THE MICROBIC FLORA OF BACTERIAL PLAQUES REMOVED FROM CARIOUS AND CARIOUS DENTAL ENAMEL. Jour. dental Res., 20 (1): 29-38.

A study was made of the incidence of certain aciduric and non-aciduric microorganisms in the bacterial plaques from 43 different mouths, only 3 of which were completely free of carious lesions; cultures were prepared from 80 plaques, 41 from carious and 39 from non-carious areas, the majority being from proximal surfaces.

In the non-aciduric flora 78 cultures (2 of the 80 caries plaques were incubated on acid media

only) indicated that diphtheroids constituted the most prevalent colony type and were frequently the predominant organisms in diphtheroid-positive samples; non-hemolytic, Gram-positive diplococci were most frequent in the series as a whole; three types of alpha-hemolytic streptococci (smooth colony) were by far the most prevalent in plaque flora, but were not isolated as frequently as diphtheroids; anaerobic fusiform bacilli were cultured from more than half of the samples; and various other organisms were identified.

Among the aciduric organisms, lactobacilli were predominant and were more frequent in carious than in non-carious areas of the mouth; they were, however, not found in all samples of the caries plaques.

Hemmens, Elizabeth S., J. R. Blayney, and R. W. Harrison, 1943. THE MICROBIC FLORA OF SALIVA AND DENTAL PLAQUES. Jour. dental Res., 22 (3): 205.

"Cultures of saliva and plaques taken simultaneously from 60 patients with active caries were made on acid (pH 5.0) and neutral media and compared as to relative incidence of cultivable forms. No qualitative differences were found in the floras of the 2 sources but some quantitative differences were noted. Diphtheroids, gamma streptococci, anaerobic gram negative cocci, one type of fusiform bacillus and filamentous forms were more common in plaque cultures than in the saliva and the reverse was true of yeasts, micrococci and, to a slight degree, of lactobacilli. Some other bacteria, including several species of Neisseria, and alpha and beta hemolytic streptococci, some gram positive rods, and other fusiform bacilli showed no appreciable differences in incidence in cultures from the two sources." (Complete paper.)

Hemmens, Elizabeth S., J. R. Blayney, S. F. Bradel, and R. W. Harrison, 1946. THE MICROBIC FLORA OF THE DENTAL PLAQUE IN RELATION TO THE BEGINNING OF CARIES. Jour. dent. Res., 25 (4): 195-205.

At least 27 varieties of bacteria were isolated from 939 plaques removed from 87 areas on the teeth of 44 children; those occurring in 2 percent or more of the plaques are listed. The percent of occurrence of predominant organisms from the 211 precarious plaques are: alpha streptococci, (smooth colony) 73%, and (rough colony) 41%; aciduric streptococci, 80%; diphtheroids, 66%; leptotrichia, 48%; and actinomyces, 44%. Predominant forms from the 400 transitional plaques include aciduric streptococci, 88%; diphtheroids, 78%; alpha streptococci (smooth colony) 63%; and leptotrichia, 44%. Isolated from the 328 carious plaques were aciduric streptococci, 86%; diphtheroids, 74%; S-type alpha streptococci, 53%; and lactobacilli, 47%.

A comparison of the three types of plaque showed a drop in incidence with development of the carious lesion for the following organisms: alpha hemolytic streptococci, 20%; leptotrichia, 15%; fusiform nucleatus [Fusobacterium nucleatum], 14%; some species of Neisseria, 12%; and actinomyces, 11%. Among organisms which showed a definite increase in numbers with development of the carious lesion were lactobacilli, 34%; and beta hemolytic streptococci, 10%.

Hemmeter, John C., 1907. THE DEPENDENCE OF GASTRIC SECRETION UPON THE INTERNAL SECRETION OF THE SALIVARY GLANDS. *Proc. Soc. exper. Biol. Med.*, 4 (7): 153.

The absence of gastric secretion in dogs having obstructed salivary secretion (Mikulicz's disease) or extirpated salivary glands led the author to conclude that normal gastric secretion depends upon the internal secretion of the salivary glands. [Cf: Loevenhart, 1908 m.]

Hench, Philip S., and Martha Aldrich, 1922. THE CONCENTRATION OF UREA IN SALIVA. *Jour. Amer. med. Assoc.*, 79 (17): 1409-1412.

Sixty-two of 64 estimations of the combined nitrogen (i.e., urea and ammonia nitrogen) values of the saliva of normal persons fell between 6 and 13 mg./100 cc.; of the two exceptions, one was abnormally high, the other low.

Thirty-nine of 40 estimations of combined nitrogen values in nephritis patients were constantly above 13 mg./100 cc.

A close relationship between the combined nitrogen content of saliva and the blood urea nitrogen was indicated in 22 of 24 persons; the abnormally high values obtained in two cases may possibly be attributed to mouth pollution due to poor oral hygiene.

The significance of the combined nitrogen of saliva as an index of renal functional capacity is stressed. This method may replace the determination of blood urea nitrogen; only when combined nitrogen values in saliva are high is there a need for blood studies.

Hench, Philip S., and Martha Aldrich, 1923. A SALIVARY INDEX TO RENAL FUNCTION. I. THE CLINICAL USE AND SIGNIFICANCE OF THE SALIVARY UREA INDEX. *Jour. Amer. med. Assoc.*, 81 (24): 1997-2001.

The salivary urea index was determined in 442 persons whose renal function was considered normal; 92% gave an index value of from 30 to 50 in the first or the second saliva sample. The remaining 8% had values above 50, generally indicating beginning urea retention.

In four cases of definite urea retention, the salivary urea index ranged from 32 to 306, these fluctuations being strikingly parallel with those of the blood urea content.

Estimation of the salivary urea index is suggested as a substitute for the determination of blood urea.

Hench, Philip S., and Martha Aldrich, 1924. APPARATUS FOR THE DETERMINATION OF THE SALIVARY UREA INDEX. *Jour. Amer. med. Assoc.*, 82 (15): 1194-1195.

An apparatus and procedure are described in detail for the determination of the salivary urea index.

Henderson, Marjorie, and John A. P. Millet, 1927. ON THE HYDROGEN ION DETERMINATION OF NORMAL SALIVA. *Jour. biol. Chem.*, 75 (2): 559-566.

pH determinations were made colorimetrically on saliva collected from normal individuals under the varying conditions of an average working day. The methods used have been described previously (cf. Star, 1922m, 1922n). Briefly, salivary specimens were collected under oil by means of a thistle tube. Every determination was made

immediately after ejection. 1 cc. of saliva was diluted with 9 cc. of distilled water (pH 6.9) and the pH was determined by comparison with the hydrogen ion standards of Clark and Lubs.

It was concluded that the salivary pH varies in a very definite way throughout the day; with a tendency to fall after meals to a point slightly lower than that occurring just before meals; and between meals under normal conditions to rise and approach neutrality unless food is consumed. The maximum pH range was 6.0 to 7.4. By discarding the figures obtained upon rising and those taken after a meal, the range became narrower, 6.5 to 7.1. The results using the colorimetric method were checked electrometrically using a potentiometer (giving values higher than those obtained colorimetrically). The range was found to be pH 6.2 to 7.6, or, using the narrower range, pH 6.7 to 7.3.

Henderson, V. E., and O. Loewi, 1905. ÜBER DEN EINFLUSS VON PILOCARPINE UND ATROPIN AUF DIE DURCHBLUTUNG DER UNTERKIEFERSPEICHELDRÜSE. EIN BEITRAG ZUR FRAGE NACH DEN BEZIEHUNGEN ZWISCHEN ORGAN-TÄTIGKEIT UND ORGAN-DURCHBLUTUNG. [On the influence of pilocarpine and atropine on the circulation of the submaxillary salivary gland. A contribution to the problem of the relationship between organ function and organ circulation]. *Naunyn-Schmiedeberg's Arch. exper. Pathol. und Pharmakol.*, 53 (1): 62-75.

Administration of atropine counteracts the vasodilation and secretion of the submaxillary gland effected by chordal stimulation. Atropine also suppresses the stimulatory effects of pilocarpine on glandular blood supply and salivation.

Henderson, Yandell, 1899. METABOLISM IN THE SUBMAXILLARY GLAND DURING REST AND ACTIVITY. *Amer. Jour. Physiol.*, 3 (1): 19-25.

The mineral and nitrogen metabolism of the submaxillary gland during rest and activity was studied in nine dogs. Samples of unstimulated and of chorda saliva were collected. In two cases, the animals were chloroformed to death while vigorous glandular stimulation was maintained. In all cases both submaxillary glands were removed immediately after death and examined. Saliva and solids were tested for nitrogen by the Kjeldahl method; the total nitrogen of the saliva was 0.14 g.

Henderson, Yandell, and R. L. Stehle, 1919. GAS TENSIONS IN THE TISSUES OF THE MOUTH. *Jour. biol. Chem.*, 38 (1): 67-69.

A study was made of the carbon dioxide tension of saliva and of the terminal portion of expired air voluntarily retained in the oral cavity. The terminal-expired-air was found to contain 7.5 volumes percent CO₂ while the saliva contained a CO₂ tension of 58 mm. of mercury (7 volumes percent).

Henri, Victor, and Lucien Malloizel, 1902. DE L'ACTION DE L'ATROPIN SUR LA SÉCRÉTION DE LA SALIVE SOUS-MAXILLAIRE DU CHIEN [The action of atropine on the secretion of submaxillary saliva of the dog]. *Compt. rend. de la Soc. de Biol. (Paris)*, 54 (14): 467-468.

Subcutaneous injection of 0.2% atropine sulfate into dogs resulted in a few drops of thick, viscid, and opaque saliva. Presentation of meat

before or after salt always produced a scanty salivation, but more abundant than that stimulated by salt alone. If the atropine did not completely stop salt-induced secretion, it modified considerably the physical properties, mucin content, and quantity of the saliva.

Henri, Victor and Lucien Malloizel, 1902a. VARIATION DE L'ACTIVITÉ DIASTASIQUE DE LA SALIVE SOUS-MAXILLAIRE EN RAPPORT AVEC LA NATURE DE L'EXCITANT [Variation in diastatic activity of submaxillary saliva in connection with the nature of the stimulant]. *Compt. rend. de la Soc. de Biol. (Paris)*, 54 (10): 331-333.

A series of experiments on dogs showed that the diastatic activity of submaxillary saliva was never very strong. Raw-meat-elicited saliva had the greatest activity, sugar-induced saliva was intermediate, while NaCl, quinine sulfate, acetic acid, or sand produced a saliva with very feeble diastatic activity. Changes in the activity of the saliva according to the nature of the stimulant were very rapid. Meat induced a viscous and active saliva; immediately afterward, quinine sulfate produced a liquid saliva of low diastatic activity.

Henri, Victor, and Lucien Malloizel, 1902b. SÉCRÉTION DE LA GLANDE SOUS-MAXILLAIRE APRÈS LA RÉSECTION DU GANGLION CERVICAL SUPÉRIEUR DU SYMPATHÉTIQUE [Secretion of the submaxillary gland after resection of the superior cervical sympathetic ganglion]. *Compt. rend. de la Soc. de Biol. (Paris)*, 54 (22): 760-761.

Tests were conducted on a dog with a permanent submaxillary fistula 8 days after extirpation of the superior cervical ganglion. The nature of the saliva varied with the stimulant similar to that already noted in normal dogs (Henri, 1902n) except that saliva of the normal dog contained less mucin. The quantities of saliva produced were equal.

After injection of atropine, salivation could not be induced by meat, salt, or quinine in the dog with severed ganglion, while a few drops of viscid saliva were secreted by dogs with intact nerves under similar conditions.

The authors conclude that the variability of salivary composition, adapted to different foods, is induced by the chorda tympani; the sympathetic system, on the other hand, affects the mucin content and, when cut, suppresses all salivation under atropine.

Henriques, B. L., and H. H. Chauncey, 1958. COMPARATIVE ELECTROLYTIC CONCENTRATIONS OF SUB-MAXILLARY AND PAROTID SALIVAS. *Jour. dent. Res.*, 37 (1): 28-29.

Saliva samples were collected from 15 subjects in a fasting state. Curby cups were used to collect parotid saliva while a modification of the Schneyer appliance was employed to collect the submaxillary secretion. The stimulus, 3 grams of sweetened gum base, was renewed every 5 minutes during the collection period. The inorganic components measured were: sodium, potassium, calcium, bicarbonate, chloride, and phosphate; pH and flow rate were routinely recorded. All collections were made under a layer of mineral oil. [The recorded data are tabulated to show ranges and means in both submaxillary and parotid salivas.] Comparison of the respective measurements

shows no apparent difference in flow rate, pH, and chloride between the submaxillary and parotid secretions. However, the calcium content of the submaxillary secretion was considerably greater than the parotid calcium values. On the other hand, the concentrations of sodium, potassium, bicarbonate, and phosphate were greater in the parotid secretion. (Author's abstract)

Hermann, Otto, 1928. LYSSAVIRUS IM MENSCHLICHEN SPEICHEL [Rabies virus in human saliva]. *Zeitschr. Immunitätsforsch.*, Jena, 58 (3-4): 384-388.

A brief review of the literature indicates the saliva of rabid animals to be virulent. The saliva of an 8-year old boy, who died of rabies, was injected in saline solution into muscle tissue of one young rabbit and two young guinea pigs. The rabbit died after 24 days; the guinea pig was still alive after 3-months observance. Further passage of the virus from brain tissue of the affected rabbit into other rabbits, guinea pigs, and mice is described.

Hermann, U., and H. R. Muhlemann, 1958. INHIBITION OF SALIVARY RESPIRATION AND FERMENTATION BY A FLUORIDATED CATIONIC DETERGENT. *Jour. dent. Res.*, 37 (5): 971-972.

Similar experimental caries reductions were found when a stannous fluoride or diethanol-aminoethyl-N-ethanol-octadecylamine-dihydro-fluoride (= E.2HF) was administered ad libitum in drinking water to Osborne-Mendel rats ($F^- = 0.1\%$). However, in the same experiment, the decrease in the rate of solution of intact rat molar enamel in vivo was different in the 2 groups and more pronounced in the SnF₂-group. Attention, therefore, was drawn to an additional antibacterial cariostatic mechanism of the fluoridated cationic detergent (E.2HF). The oxygen uptake and anaerobic glycolysis of paraffin-stimulated human saliva to which E.2HF, E.2HCl, and NaF, respectively, were added at different F^- concentrations in aqueous solutions were determined by the Warburg method on 15 subjects. Inhibition of salivary respiration compared to controls was 88 percent when using E.2HF at 10 ppm F^- and under otherwise identical conditions, 68 percent when using NaF at 100 ppm F^- . The reduction of anaerobic glycolysis by E.2HF was 91 percent at 3.2 ppm F^- ; by NaF 65 percent at 32 ppm F^- . Equimolar concentrations of E.2HF and E.2HCl showed a similar inhibitory effect on respiration and fermentation, indicating an antibacterial action due to the organic part of the molecule. Also, the onset of inhibition was acute with NaF and gradual with E.2HF or E.2HCl. Casein treated with 0.2 M E.2HF and thoroughly washed thereafter inhibited respiration and anaerobic glycolysis by 48 percent and 65 percent when added to the saliva-buffer-mixture. E.2HCl, in the casein adsorption test, was only active under anaerobic conditions (39 percent inhibition). (Author's abstract)

Hess, W. C., and B. T. Smith, 1948. THE SALIVARY AMYLASE ACTIVITY OF CARIOUS AND NONCARIOUS INDIVIDUALS. *Jour. dental Res.*, 27 (5): 593-598.

Employing the Rolin-Wu method of determining the total reducing sugar in saliva, the salivary amylase activity was measured in serially diluted salivas of 56 individuals (20 noncarious and 36 carious). No significant differences between the

two groups of individuals were observed; no significant diurnal variations occurred in the same individual.

Hess, W. C. and B. T. Smith, 1949. THE ASCORBIC ACID CONTENT OF THE SALIVA OF CARIOUS AND NONCARIOUS INDIVIDUALS. Jour. dental Res., 28 (5): 507-511.

Using the colorimetric method of Roe and Keuther (described in detail), a comparison was made of the ascorbic acid content of the salivas of 31 caries-free individuals with that of the saliva of 54 carious individuals. The difference between the carious values (0.218 mg./100 cc.) and the non-carious values (0.117 mg./100 cc.) was insignificant. No correlation was observed between the ascorbic acid content and the number of carious surfaces, or age.

Heymans, C., 1922. ACTION HYPERTHERMISANTE, SALIVAIRES ET CARDIAQUES DE LA THIONINE [Hyperthermic, salivary, and cardiac effects of thionine]. Compt. rend. de la Soc. de Biol. (Paris), 86 (13): 742-744.

Intravenous administration of thionine to two dogs was found to produce an increase in salivary secretion. This effect was considered analogous to that produced by pilocarpine.

Heyward, B. H., 1881. ON THE PRESENCE OF AMMONIA IN HUMAN SALIVA. Chem. News and Hour. phys. Sci., 44 (1144): 208.

Results are presented of experiments using Nessler's reagent which indicate that ammonia definitely exists as a normal constituent of the saliva of healthy individuals, and that the parotid and submaxillary salivary glands are the greatest contributors of the substance to mixed salivary secretions.

Hill, Iden H., 1955. EVANSTON DENTAL CARIES STUDY XII. A SURVEY OF LACTOBACILLUS COUNTS WITH REFERENCE TO UNTREATED CARIOUS SURFACES BEFORE AND AFTER EXPOSURE TO FLUORIDATED WATER. Jour. Dental Res., 34 (2): 178-187.

The effect of the addition of sodium fluoride to drinking water on salivary lactobacillus counts and on dental caries activity was studied in 23,000 school children of two age groups: 6 to 8, and 12 to 14 years of age. Paraffin-stimulated samples of saliva were collected once a week, prior to a dental examination, and the resultant lactobacillus counts grouped into three divisions: low, 0 to 10,000 colonies; moderate, 10,000 to 50,000 colonies; and high, 50,000 or more. Results show that after an 82-month period of fluoridation (1946-1953) the negative cases in the low count division increased from 43.75 to 57.57% in the younger group, and from 39.13 to 42.63% in the older group of children. Among the younger group the low division decreased from 66.13 to 63.52%, the moderate division increased from 21.37 to 27.45%, and those in the high count division decreased significantly from 12.50 to 9.03%. Among the older children the low count division decreased from 61.6 to 46.57%, the moderate count division increased significantly from 29.91 to 47.65%, and the high count division, from 4.49 to 5.78%. A general decrease in caries activity was found in both groups of children at the end of the study period. It is assumed that shifts may be related to the sodium fluoride in the water.

Hill, T. J., B. White, M. Matt, and S. Pearlman, 1949b. A BIOLOGICALLY ACTIVE SALIVARY FRACTION POSSIBLY RELATED TO CARIES SUSCEPTIBILITY. Jour. dental Res., 28 (6): 645-646.

"Saliva has been fractionated and a portion obtained which may be an influence in dental caries susceptibility. The extract has been recovered in quantities of from .01 to .04 mg. per ml. of saliva. In these preliminary extractions, larger amounts have been recovered from salivas of people resistant to dental caries. This extract inhibits the growth of certain bacteria; when injected into animals, it produces a prolonged hyperglycemia which suggests that its action may be the interference with carbohydrate metabolism. When added to whole fresh saliva, it retards the rate of acid production. When incorporated in dextrose broth, the rate of growth of *Lactobacillus acidophilus* is in inverse relation to the amount added. Two milligrams per milliliter completely stops the growth of lactobacilli. Smaller amounts suppress the growth for periods of 24 to 48 hours. Injection of salivary extract into rats increased the peak of the glucose tolerance curve above that which could be explained upon the basis of fright reaction to the injection. The return of the blood sugar level to normal was delayed. The nature of the material has not yet been determined. It is known to be soluble in water but insoluble in alcohol or ether. It is thermostable and not dialyzable. Efforts to identify the material are now being made." (Complete paper.)

Hill, Thomas J., 1939. THE INFLUENCE OF SALIVA UPON THE GROWTH OF ORAL BACTERIA. Jour. dental Res., 18 (3): 214-224.

An extensive review of the influence of saliva on the presence and growth of oral microbes considering: "1. The amount of saliva secreted and the mechanical factor involved. 2. The presence of some substance, lysozyme, in the saliva which has bacteriolytic power. 3. The presence of other organisms and the resultant mutual bacterial antagonisms. 4. The presence of substances which destroy, inhibit growth, or so change the organisms that they lose their pathogenicity."

Hill, Thomas J., 1939a. A SALIVARY FACTOR WHICH INFLUENCES THE GROWTH OF *L. ACIDOPHILUS* AND IS AN EXPRESSION OF SUSCEPTIBILITY OR RESISTANCE TO DENTAL CARIES. Jour. Amer. dental Assoc., 26 (2): 239-244.

Paraffin-activated saliva was obtained from both caries-free and caries-susceptible subjects. To 4 cc. of centrifuged saliva was added 1 cc. of 12% dextrose and 1 cc. of a 1:10,000 dilution of a 48-hour culture of *Lactobacillus acidophilus* in dextrose beef broth (pH 5.1). After thorough shaking, culture plates were made at intervals for 24 hours. 0.1 cc. of saliva, plus the dextrose and organisms, were plated on tomato juice-agar and incubated for 4 days. The culture plates indicated that the saliva exhibits definite antibacterial properties within 24 hours following plating.

In another series better results were obtained when 1 cc. of culture dilution containing about 6000 organisms was implanted in 4 cc. of centrifuged saliva and 1 cc. of 12% dextrose. With this technic it was observed that after the first 6 to 8 hours, there was always a reduction in the

number of organisms that grew on newly made plates, but that there was a difference in the rapidity of reduction: from 24 to 48 hours elapsing before negative variation in the intensity of some unknown factor in the saliva which permits or deters the growth of L. acidophilus and that this variation is consistent with the presence or absence of dental caries.

Saliva from caries-free persons did not lose its capacity to destroy L. acidophilus under the following conditions: (1) When centrifuged and kept under refrigeration (4.4°) for periods up to 30 days. (2) When placed in a dialyzing bag and dialyzed for 24 hours in repeated changes of distilled water. (3) When heated to 80° for a period of 1 hour. However, saliva from caries-free persons when subjected to the bodies of dead L. acidophilus soon lost its ability to inhibit the growth of the cultured organisms.

Hill, Thomas J., 1941. GROWTH OF ORAL LACTOBACILLI IN SALIVA. Jour. dental Res., 20 (3): 266.

"Saliva was subjected to various treatments in order to determine which factors influence lactobacilli growth. Results were based chiefly on growth of lactobacilli inocula containing known numbers of bacteria in salivas. 1. Refrigeration (4°C.) does not materially change the ability of saliva to support bacterial growth. 2. Centrifuged saliva shows no change. 3. Filtering mechanisms result in salivary media less suitable for bacterial growth. 4. Saliva collected from a caries-susceptible patient shows a decreased lactobacilli growth if boiled for 10 minutes. 5. Heating salivas at lower temperatures for longer periods of time gives similar results. Incubation of fresh "susceptible" saliva for 24 hours converts such saliva from an originally fertile medium to a poor medium for lactobacilli growth. 6. "Resistant" saliva collected from patients free from dental caries does not support acidophilus growth. With addition of a thoroughly washed, heat-killed strain of oral lactobacilli, staphylococci, Type I pneumococci, or hemolytic streptococci to such saliva, inoculated lactobacilli grow well. 7. Salivas with greater percentages of dextrose than a 2 percent solution show no differences in growth. 8. With salivas which have been studied for 6 months, no correlation of caries susceptibility could be made with buffering index determinations. 9. On 4 test samples of saliva, the 2 resistant salivas showed a cocarboxylase content 2 1/2 times that of the 2 susceptible salivas." (Complete paper.)

Hill, Thomas J., 1941. THE INFLUENCE OF IMMUNOLOGIC FACTORS ON DENTAL CARIES. Jour. Amer. dent. Assoc., 28 (1): 109-113.

A review is presented on the immunologic aspects of the etiology of dental caries in which the presence of humoral factors in saliva, hereditary influences, and Lactobacillus acidophilus agglutinins are discussed.

Hill, Thomas J., and Albert H. Kniesner, 1947. EFFECT OF PENICILLIN DENTIFRICE ON ORAL LACTOBACILLUS COUNTS. Jour. dental Res., 26 (6): 454-455.

"Two hundred and forty institutionalized boys ranging in age from 8 to 16 years inclusive are being studied for changes in dental caries

susceptibility with the use of a commercially-prepared powdered dentifrice containing 500 units of penicillin per gram. The average of 2 lactobacillus counts was accepted as the initial degree of susceptibility. All salivary specimens were collected before breakfast and before brushing the teeth. One hundred and fifty-four boys were given the penicillin-containing powder and 86 were given plain tooth powder. They were instructed to brush their teeth with this dentifrice twice a day. An arbitrary classification of susceptibility followed was 0 to 100 per ml. saliva, negative; 100 to 1,000, ±; 1,000 to 10,000, +; 10,000 to 30,000, ++; 30,000 to 50,000, +++; 50,000 and over, +++. No change in susceptibility was recorded unless the counts passed at least half the range of adjacent classifications. Preliminary findings at 5 months revealed that the susceptibility of the control group decreased to negative counts in 9% of the individuals, and of the experimental group, 21%. Of those whose susceptibility changed, an increase in susceptibility was observed in 20% of the controls and only 4% of the penicillin group. Of the controls, 43% decreased in classified susceptibility and 65% of the penicillin group decreased." (Complete paper.)

Hill, Thomas J., and B. White, 1948. ACID PRODUCTION IN SALIVA IN-VITRO EXPERIMENTS. Jour. dental Res., 27 (6): 734-735.

"In-vitro experiments with saliva do not stimulate the rate of acid production in the mouth. As sugar clearance in the mouth occurs in a relatively short time, the rate of acid production in saliva was studied for 90 minutes. Attempts to produce in in-vitro experiments rates of acid production comparable to that of the mouth could be made with a concentration of the residual matter of the saliva but could not be produced by increases in the number of lactobacilli. Acid production was entirely inhibited when filtered or highly centrifuged saliva was used even when large numbers of lactobacilli were added. These experiments indicate that some constituent of the saliva present in the residual matter after centrifugation or filtration acts as an agent in the rapidity of acid production." (Complete paper.)

Hill, T. J., B. White, M. Matt, and S. Pearlman, 1949. A BIOLOGICALLY ACTIVE SALIVARY FRACTION POSSIBLE RELATED TO CARIES ACTIVITY. Jour. Amer. dental Assoc., 38 (5): 656-657.

A water-soluble salivary component, occurring in concentrations of .01 to .04 mg./ml. and extracted by fractionation, was found to have the properties of inhibiting bacterial growth (Lactobacillus acidophilus) in dextrose broth and of producing a prolonged hyperglycemia (when injected into 8 rats) suggestive of an interference with the carbohydrate metabolism. The material (not yet identified) is insoluble in alcohol or ether, is thermostable, and non-dialyzable.

Hill, Thomas J., and Betty J. White, 1949a. ACID PRODUCTION IN SALIVA IN-VITRO EXPERIMENTS. Jour. dental Res., 28 (4): 391-397.

A series of seven experiments were carried out, studying sucrose degradation in whole, pooled saliva and variously treated salivas (cotton and paper filtered or Seitz filtered, centrifuged, and treated with ultrasonic rays), either totally free of lactobacilli or in combination with numbers

ranging 38,000 lactobacilli/cc. saliva to 200 million/cc. Strong evidence was obtained that factors other than lactobacilli (but not identified) are largely responsible for rapid acid production in saliva.

Hill, Thomas J., C. Rasch, and B. Wollpert, 1953. THE DEVELOPMENT OF ORGANISMS WITH PENICILLIN RESISTANCE ASSOCIATED WITH THE USE OF A PENICILLIN DENTIFRICE. Jour. dent. Res., 32 (4): 453-457.

An examination was made of the saliva of 100 children who had taken part in an experiment using a penicillin dentifrice for 1 year, to determine if there had been an increase in the prevalence of organisms resistant to this antibiotic. A total of 814 cultures were made; these included strains of Streptococcus viridans and strains of organisms other than Str. viridans from the experimental group and from a control group. Sensitivity tests of Str. viridans to varying concentrations of penicillin indicated that the users of penicillin dentifrice have a higher percentage of organisms which require 0.5 unit or more of penicillin in order to inhibit them. It was also noted in this group that a higher percentage of the organisms other than Str. viridans require concentrations of 1.0 unit or more of penicillin to inhibit them. A greater number of users of the dentifrice have resistant Str. viridans and other organisms than non-users.

Hill, T. J., M. M. Matt, and S. Pearlman, 1955. EXTRACTION PROCEDURE AND SOME CHARACTERISTICS OF A BIOLOGICALLY ACTIVE SALIVARY FRACTION. Jour. Dental Res., 34 (5): 695.

A technique is described for the extraction of a hyperglycemic factor from the supernatant fluid of dentrifuged fresh saliva. The active fraction, a white (sometimes brown) amorphous powder, produced hyperglucemia in rats, and inhibited the in vitro growth of Lactobacillus acidophilus 4646. The extraction product has been kept under vacuum at room temperature for months without apparent loss of activity. It is water soluble (1 to 2 parts /1000), and insoluble in alcohol concentrations over 40%. Electrophoretic analysis shows 3 moving components in relative proportions of 60%, 35%, and 5%. Faintly positive biuret and tyrosine reactions were obtained chemically; a fine precipitate is given with trichloroacetic acid. This fraction may be a polypeptide, stable over a broad pH range. (From author's abstract)

Hine, Maynard K., 1936. DAILY OBSERVATIONS OF BACTERIAL INHIBITION BY SALIVA. Jour. dental Res., 15 (5): 305-306.

One thousand and eighty-eight studies were made of the bacterial inhibitory action of saliva using the method of Fleming [cf. Fleming, 1924m.], in which the inhibitory action is demonstrated by the appearance of clear zones around saliva-filled wells cut into seeded plates. Five different bacteria were seeded on various media (i.e.), Micrococcus lysodeikticus, on plain agar; Lactobacillus acidophilus, on galactose-whey agar; Streptococcus, beta-hemolytic type, on Savita plus 1 percent horse-serum agar; Staphylococcus albus [Micrococcus pyogenes var. albus], two strains; and S. aureus [M. pyogenes var. aureus], on Kulp's tomato-juice agar, and the action of

resting saliva from 4 patients was observed. The inhibitory powers varied haphazardly from patient to patient and from day to day (or were dependent upon undetermined factors). If exact technique is employed, duplicate results agree within 1 mm. The inhibitory "principles" were demonstrated in 91% of the 1088 tests.

Hine, Maynard K., and Basil G. Bibby, 1939. VARIATIONS IN THE ORAL FLORA FROM TIME TO TIME. Jour. dental Res. 18 (1): 61-66.

Periodic examinations of various parts of the buccal cavity were made in an effort to determine a possible constancy in the composition of the bacterial flora.

Little constancy was seen in the percentages of the various groups of microorganisms occurring at different times in smears from the posterior lower molar, the mouth cavity, mouth washings, and occlusal fissure. However, the daily total percentages of coccal forms were fairly constant, the Gram-positive forms being consistently more numerous than the Gram-negative. In the materials obtained from the lower molars, the numbers of Gram-positive cocci were consistently more than 16% higher than those of the Gram-negative. In general, a higher percentage of filamentous groups was present than were those of the fusiform or bacillary types, the Gram positive bacilli generally occurring in the smallest numbers.

Fortnightly variations resembled those of the daily series. Marked differences occurred between the flora of various mouths; lesser differences, between the organisms of the disto-gingival surface of the lower molars and those from the buccal surface of the upper molars. A general trend upward or downward in the number of particular types of organisms was noted simultaneously in some mouths, while others maintained consistently high or low levels of certain groups of organisms.

The author considers none of the differences to be large or constant enough to be significant statistically.

Hine, M. K., and J. F. O'Donnell, 1943. INCIDENCE OF UREASE PRODUCING BACTERIA IN SALIVA. Jour. dental Res. 22 (2): 103-106.

Four hundred and five salivary samples from 72 patients were cultured and studied for incidence of urease-producing organisms.

The medium (2 g. peptone, 5 g. NaCl, 1000 cc. distilled water, and 20 cc. of a 0.2% alcoholic solution of thymol blue) was adjusted to a pH of 6.8 and separated into test-tube portions of 10 cc. each. After sterilization, 0.5 cc. of filtered 10% carbamide solution were added to each tube. 2 cc. of unstimulated saliva were added to each tube and the tubes were incubated at 37°C. for 48 hours.

A comparison was made of the color changes of the incubated test tubes. After tabulation of the results, the author divided the persons into 4 groups with decreasing urease activity: Group I, 154 persons (38%) with active urease production; Group II, 111 (27.4%); Group III, 111 (27.4%); and Group IV, 29 (7.2%) with no urease production. It was seen, therefore, that in 376 persons (or 92.8%) there was evidence of urease production, and in 265 (65.4%), production was in appreciable amounts.

A correlation was made of these results with the incidence of *Lactobacillus acidophilus*. In general, more active urease-producing bacteria were found in the samples which gave low *L. acidophilus* counts and in which acid production was limited, than in those with high *L. acidophilus* counts and much acid production.

Hinkins, J. E., 1902. WHAT CHEMICAL INFLUENCE HAS SALIVA ON CEMENT? *Dental Cosmos*, 44 (6): 564-569.

A literature review of the various analyses and constituent elements of saliva. The organic constituents noted are mucin, ptyalin, protein and potassium thiocyanate; the inorganic substances include small quantities of chlorine and phosphoric acid in combination with potassium, sodium, calcium, and magnesium, also small quantities of sodium carbonate. The author considers that, under normal circumstances, none of the constituent elements of saliva and cement are "derogatory to each other."

Hinkins, J. E., G. W. Cook, and J. P. Buckley, 1905. PARTIAL REPORT OF COMMITTEE APPOINTED BY THE CHICAGO DENTAL SOCIETY TO INVESTIGATE EROSION OF TEETH. *Dent. Rev.*, 19 (4): 295-331.

Etiological factors (including saliva) involved in tooth erosion are discussed and several illustrative cases are presented.

Hinkins, J. E., G. W. Cook, and J. P. Buckley, 1905a. REPLY TO DR. KIRK'S CRITICISM OF THE PARTIAL REPORT OF THE COMMITTEE APPOINTED BY THE CHICAGO DENTAL SOCIETY TO INVESTIGATE EROSION OF TEETH. *Dent. Rev.*, 19 (8): 687-694.

A reply is made of Kirk's (1905) criticism of the authors' previous discussion of the etiology of dental erosion as well as the role played by saliva in such processes.

Hirata, Goichi, 1912. UBER DIE DIASTATISCHE KRAFT DES MENSCHLICHEN MUNDSPEICHEL [On the diastatic power of human oral saliva]. *Biochem. Zeitschr.*, 47 (1): 167-183.

The daily fluctuation in the diastatic power of human saliva is not considerable. It is not influenced by time of meals, the amount of food ingested or saliva secreted, sex, or age.

Hisada, K., 1930. ÜBER DIE REFLEKTORISCHE SPEICHELSECRETION DURCH MAGENAUFBLÄHUNG [Reflex secretion of saliva following distention of the stomach with air]. *Pflüger's Arch. ges. Physiol.*, 224 (2): 249-257.

The effects of gastric distention on the salivary secretion of the submaxillary gland were examined in the curarized dog. After the peritoneal cavity has been opened and the severed vagus stimulated for 3-5 minutes, salivation increased considerably. After distention of the stomach by air, salivation increased ten times. Similar results were seen when the stomach was distended with saline solution warmed to 38°-55°C. No increase in salivation was noted after severing the vagus or the chorda. The properties of the saliva following gastric distention were the same as those of the normal saliva: not too liquid, rich in dry and in organic substances. The increase of the blood pressure of the submaxillary gland and the results of the experiments noted following severing of the

chorda make it clear that the centrifugal course of the salivary reflexes is mostly conditioned by the chorda.

When the stomach was distended with a rubber balloon, salivation increased parallel with inner gastric pressure. Following resection of the cervical portion of both vagus nerves, salivary reflex was completely inhibited.

Hizume, K., 1924. ZUR KENNTNIS DER DIASTASEN. ZUGLEICH EIN BEITRAG ZUR FRAGE DER ZWEIENZYMTHEORIE [On diastases. Contribution to the question of the two-enzyme theory]. *Biochem. Zeitschr.*, 146 (1-2): 52-71.

The hydrolysis and the saccharification by the animal salivary diastase were both activated by neutral salts. Among the halogen salts, chloride and bromide had considerable effect, while iodine and fluoride had no effect at all. A small amount of serum when diluted with water in the ratio of 1:100 increased the hydrolytic activity of the salivary diastase. Dialysis only weakened but did not completely inhibit salivary hydrolysis. Nitration activated both hydrolysis and saccharification of the enzyme; the effect was especially strong with dialyzed saliva. Sulfation had no effect on the untreated saliva but activated both the hydrolysis and saccharification activity of dialyzed saliva. Alkalis and acids had similar effects on both chemical processes. The behavior of malt diastase to salts was refractory in both reactions. The saccharification action of the salivary amylase could be protected against heat by the presence of maltose and glucose, chloride, bromide, sodium chloride as well as by diluted serum (1:100). Nitration on the other hand, did not exercise any protection against heat.

Höber, R., and R. Ferrari, 1933. UNTERSUCHUNGEN ÜBER DIE CHEMODYNAMIK DER DRÜSEN [Investigations of the chemical kinetics of glands]. *Klin. Wochenschr.*, 12 (11): 433.

Study was made of the isolated submaxillary gland of the cat, perfused with hemoglobin - Ringer solution. In the tests potassium cyanate or moniodide acetic acid were added to the Ringer solution and the gland received chordal stimulation. Analysis of the chordal saliva showed a considerable increase in its chloride and the potassium content after addition of either substance to the perfusion.

Hoerman, K. C., H. R. Englander, and I. L. Shklar, 1955. VARIATIONS IN SALIVARY PHOSPHATASE ACTIVITY. *Jour. Dental Res.*, 34 (5): 696.

A study was made of phosphatase activity of human saliva subjected to centrifugation and freezing at -40°C. Twenty-five ml. samples of saliva were collected from each of 30 male naval personnel, aged 17 to 29 years. A portion of each sample was tested for enzyme activity in both the whole and supernatant states. The remaining portion of the salivary sample (15 whole, and 15 supernatant), was divided into 7 aliquot parts, and was frozen at -40°C for subsequent testing at intervals of up to 10 weeks.

Results show that whole saliva has 50% greater enzyme activity than has the supernatant portion; acid phosphatase activity is 60% greater than that of the supernatant. Alkaline phosphatase activity was variable in whole and supernatant frozen salivas, ranging in increases up to 80%, and

decreases to 46%. The acid phosphatase activity of the whole and supernatant frozen salivas increased by 35 and 38% respectively. Results, in the case of acid phosphatase activity, indicate an enzyme source in the saliva based on the cell destructive action of freezing. (From author's abstract)

Hoerman, K. C., H. R. Englander, and I. L. Shklair, 1956. *LYSOZYME: IT CHARACTERISTICS IN HUMAN PAROTID AND SUBMAXILLO-LINGUAL SALIVA*. *Proc. Soc. exper. Biol. Med.*, 92 (4): 875-878.

Parotid saliva, stimulated by chewing sweetened gum, was collected from the capped orifice of the right parotid duct in 100 normal males, aged 17 to 26 years. Turbidimetric assay of lysozyme activity, measured against egg white lysozyme standards, showed a variable salivary content having a mean value of 2.3 ± 14.3 ug./ml. and a range of 4.5 to 80.0 ug./ml. Submaxillary-sublingual saliva, drawn from the floor of the mouth by gentle negative pressure, and parotid saliva from the bilaterally capped ducts were collected from 30 subjects after salivary flow was stimulated by application of 3% acetic acid to the tip of the tongue. The mean lysozyme content of the mixed bilateral parotid secretion was 15.0 ± 9.2 ug./ml., and the range 5.0 to 42.0 ug./ml. The submaxillary-sublingual saliva had a mean lysozyme titer of 73.4 ± 29.3 ug./ml., and a range of 9.0 to 148.0 ug./ml. All lysozyme activity disappeared on a 45-minute heating of parotid saliva at 60°C and of submaxillary-sublingual saliva at 90°C; the greater thermostability of the submaxillary-sublingual saliva apparently being due to its higher salivary protein content. Lysozyme titers were less than predicted in 27 of 30 cases in tests of equimixtures of 1/20 dilutions of parotid and submaxillary-sublingual salivas. A "mucopolysaccharide" isolated from the submaxillary-sublingual saliva showed no lysozyme activity but inhibited lysozyme activity of parotid saliva; the inhibition is considered competitive in nature.

Hoerman, K. C., and W. E. Robinson, 1957. *ON THE DETERMINATION OF HUMAN SALIVA ALDOLASE ACTIVITY*. *Jour. dent. Res.*, 36 (6): 852-861.

A standardized modification of the Sibley-Lehninger (*Jour. biol. Chem.*, 177: 859, 1949) method for determination of aldolase activity is presented with optimum experimental conditions outlined for use in the quantitative, colorimetric determination of aldolase activity in whole (supernatant) human saliva. The method is considered somewhat less satisfactory in demonstrating aldolase activity in human parotid saliva. Investigation of the inhibitory properties of cysteine on salivary aldolase activity and filtrates of oral lactobacilli and yeasts suggests oral yeasts and lactobacilli as the source of such activity. Preliminary findings show the mean aldolase activity in the supernatant saliva of 36 male adults, aged 17 to 22 years, (expressed as cu. mm. of fructose-1, 6-diphosphate split per hr.), to be 26.05 ± 20.32 units/ml., and the mean parotid salivary aldolase activity to be 6.57 ± 2.61 units/ml. The mean aldolase activity in the supernatant saliva of 5 caries-free individuals from the group was 13.20 units/ml.

Hofbauer, Ludwig, 1897. *TÄGLICHE SCHWANKUNGEN DER EIGENSCHAFTEN DES SPEICHEL* [Daily variations in the properties of the saliva]. *Arch. ges. Physiol.*, 65 (9-10): 503-515.

Human saliva samples were collected several times during the day, before and after meals. The salivary fluctuations and changes in composition, partly due to spontaneous reasons and partly conditioned by nutrition, are outlined and compared.

Hoffmeister, W., and H. Albrecht, 1953. *DIE SPEICHELELEKTROLYTE UND IHRE DIAGNOSTISCHE BEDEUTUNG. UNTERSUCHUNGEN AM MENSCHEN UNTER BESONDERER BERÜCKSICHTIGUNG ENDOKRINER STÖRUNGEN* [Salivary electrolytes and their diagnostic importance. A study in man under special consideration of endocrine disturbances]. *Klin. Wochenschr.*, 31 (23-24): 567-572.

The electrolyte content of human pilocarpine-stimulated saliva was studied to determine the cellular electrolyte condition and the influence exercised upon it by suprarenal corticoids. The potassium content was determined according to Rappaport, the sodium content according to Folling, and the 17-ketosteroids according to Zimmermann. Results showed a close correlation between the hourly aqueous content and the sodium and potassium content of saliva of normal subjects. Deviations from the computed curve for the sodium content were characteristic of disease; the potassium curve was much less typical. The salivary sodium content was greatly increased in subjects with deficient suprarenal cortical function (pituitary insufficiency, Addison's disease, adynamy), indicating a high cellular sodium content; the potassium curve was somewhat lowered. In patients where increased suprarenal cortical function was suspected the salivary sodium curve was far below normal, while the potassium curve was slightly raised.

Hoffmeister, W., and A. Albrecht., 1953a. *SCHLUSSWORT ZUR STELLUNGNAHME VON E. OCKELMANN* [Reply to E. Ockelmann's point of view]. *Klin. Wochenschr.*, 31 (47-48): 1117.

The statistical method used in computing the electrolytic values of saliva (Hoffmeister, 1953m) is defended.

Holmes, J. H., and M. I. Gregersen, 1939. *A STUDY OF THE CHARACTER AND THE MECHANISM OF THE THIRST INDUCED BY THE INTRAVENOUS INJECTION OF HYPERTONIC SALT SOLUTION*. *Amer. Jour. Physiol.*, 126 (3): 537-538.

Changes in salivary flow may be an important factor in the mechanism of salt thirst. The intravenous injection into man of 300 cc. of 5 percent NaCl solution results in an immediate drop in salivation to one-tenth or less of its normal value. Ingestion of 500-800 cc. of water 20 minutes before the salt injection prevents the drop in salivary flow, while thirst is absent or slight.

Holmes, Joseph., and Magnus I. Gregersen, 1947. *RELATION OF THE SALIVARY FLOW TO THE THIRST PRODUCED IN MAN BY INTRAVENOUS INJECTION OF HYPERTONIC SALT SOLUTION*. *Amer. Jour. Physiol.*, 151 (2): 252-257.

Intravenous injection of 250 to 300 cc. of a 5 percent sodium chloride solution was administered to each of 16 adult males who were receiving salt injections for the treatment of peripheral vascular disease. In all of 25 tests the salivary flow was reduced immediately after the injection; in 20 of the 25 tests the flow was reduced by more than 50 percent of the flow determined before administration of the salt solution. The drinking of water relieved the thirst and restored salivary flow to normal levels. Dry mouth followed injections of 100 to 150 cc. of the 5 percent solution.

Administration of 300 cc. of a 0.9 percent sodium chloride solution containing one half grain of papverine to 5 of the subjects, produced no significant change in 4, and a 40 percent decrease in salivary flow in 1 case. In 8 tests using 5 of the subjects, ingestion of 400 to 600 cc. of water 20 to 30 minutes before salt injection alleviated the severe thirst usually experienced, and prevented the reduction in salivary flow. A rise in serum chloride and a drop in serum protein concentrations were also noted.

Holmes, Joseph H., and Magnus I. Gregersen, 1948. ORIGIN OF THIRST IN DIABETES INSIPIDUS. *Amer. Jour. Med.*, 4 (4): 503-510.

Five cases of diabetes insipidus were studied and the effects of the following were noted: imbibition of fluids at will, pituitrin therapy, drinking of large amounts of water, and high salt intake. The plasma volume, hematocrit, fluid intake, urinary output, body weight, and salivary flow were measured at regular intervals. Although the salivary rates varied during the day, measurements taken at the same daily periods were found to be rather constant.

Without therapy or treatment, the subject's salivary rate was abnormally low, but was increased by the administration of pituitrin, with an increase in salivation occurring at the time of reduction of the thirst sensation. However, there was no indication that the injection of pituitrin acted specifically upon salivary activity. The drinking of fluids to the extent that thirst was abated (fluid forcing), likewise, increased salivation, but a high salt intake decreased salivation to the point observed in the controls (untreated subjects).

Further experimentation, using healthy subjects, revealed that pituitrin administration and fluid forcing increases the salivation of normal subjects to the same extent as that of the individuals with diabetes.

It is stated, by the authors, that, based on the above data, salivation and thirst in diabetes insipidus can be explained by Cannon's theory of thirst, and it is suggested that the thirst mechanism and salivary flow changes, as occurring in untreated cases of the disease, are identical with those encountered in dehydration states.

Holmes, J. H. and A. V. Montgomery, 1951. OBSERVATIONS ON RELATION OF HEMORRHAGE TO THIRST. *Amer. Jour. Physiol.*, 167 (3): 796.

In an investigation of thirst associated with hemorrhage and trauma, no consistent reduction in salivary flow was found in 50 male blood-bank donors hemorrhaged 500 cc. (approximately 5-10% of the blood volume).

Holmes, Joseph H., and A. V. Montgomery, 1953. THIRST AS A SYMPTOM. *Amer. Jour. med. Sci.*, 225 (3): 281-286.

A review is presented of a number of clinical conditions in which thirst may be important to the diagnosis or therapy. These include dehydration, cardiac edema, polyurias of endocrine origin, hemorrhage, diseases altering salivary secretion, and emotional disturbances. The rate of salivary secretion may be used as an indicator to distinguish true thirst from excessive water drinking.

Holzlohner, E. [and A. Airapetianz], 1933. DIE SEKRETION DER SPEICHELDRÜSEN BEI SYMPATHICUS-REIZUNG [The secretion of the salivary glands during sympathetic stimulation]. *Klin. Wochenschr.*, 12 (3): 125.

Sympathetic secretion of the submaxillary gland in the dog was studied by means of a tachograph. The tachogram showed rates of sympathetic salivation which could equal those of chordal salivation; the reduced flow after sympathetic stimulation was due to a shorter secretion period not over 12 seconds. The secretion curve showed a latent period approaching that occurring after chordal stimulation, followed by a rapid increase in the secretion rate and then a rapid decrease. The secondary rise in the curve, noted on a chordal tachogram, was always absent. Sympathetic stimulation is considered to induce an expression of saliva from the gland. When both the chorda and the sympathetic nerves were stimulated at short intervals general interaction of both stimulations induced typical changes in the standard form of each tachogram.

Hood, Marion, and Lloyd Arnold, 1937. THE RELATIONSHIP BETWEEN ORAL AND GASTRIC BACTERIAL FLORA. *Amer. Jour. dig. Dis. Nutr.*, 4 (1): 40-43.

The relationship between oral and gastric floras was studied, including a qualitative and quantitative comparison of the microorganisms, the rates of disappearance of a test organism (*B. prodigiosus* [*Serratia marcescens*]) from both localities, and the effect of removal of saliva on the hydrogen ion concentration and flora of the gastric contents. The flora of the stomachs of 25 fasting individuals (aspirated by means of Rehfuß tubes) and that of their respective oral cavities was markedly similar. The rates at which the test organism disappeared averaged 2 hrs. and 36 min. after seeding in the oral cavities and 1 hr. and 18 min. in the stomach. The diversion of salivary flow from the stomach (by means of dental suction tubes) for two hours had no significant influence on the bacterial flora of the stomach. Saline solution or a 1:4000 dilution of hexylresorcinol were equally effective in reducing the exogenous microbial flora of mouth and stomach, probably due to a mechanical rinsing action.

The estimated number of culturable bacteria in the salivas of several subjects over a 24-hr. period ranged from 2,592,000 to 79,120,800; the saliva flow ranged from 264 to 2,280 cc. over the 24 hr. period. Values for 24 hrs. were based on 24-hr. observations periods.

Hopewell-Smith, Arthur, 1915. CONCERNING THE PRODUCTION OF DENTAL CARIES. *Dental Cosmos*, 57 (9): 990-1002.

Various tests were conducted on the mixed saliva of persons who had dental caries as well as those who did not. The acidity or alkalinity of these salivas was determined after the saliva had been incubated with or affected by the presence in the mouth of several sugars, chocolates, candies, or gelatins. It was found that salivas from persons of both types varied in reaction at different times of the day and even between different sides of the same mouth. Results of the tests indicated that alkaline saliva becomes acid when held at body temperature, that addition of glucose increases this acidity whether or not bacteria from caries are present. Salivary reactions disturbed by the use of candies etc. return to normal almost immediately.

"Acid drops", "barley sugar", etc. are considered bacteriophobe while chocolate, caramel, toffee, etc. are considered to be bacteriophil to bacteria recovered from carious dentin. Superficial changes in the enamel leading to decalcification of the enamel can be produced by such sweetmeats as chocolate and caramel in the presence of very acid saliva from the mouth of persons either immune or non-immune to caries.

An examination of the gingival trough of 7 persons with normal mouth structure revealed the presence of microorganisms in all cases. Tests were also conducted on the relative growth of bacteria isolated from dental caries in media composed of mixed saliva, agar and various food substances. Pepper, fruit juices, starch and candies except those flavored with acid or sticky in character are considered bacteriophilic, while mustard, vinegar, acidulated candies, glucose and perhaps cane sugar are bacteriophobic.

Horsely, Victor, 1884. ON THE FUNCTION OF THE THYROID GLAND. *Proc. Roy. Soc., London*, 38 (235): 5-7.

A study of a thyroidectomized monkey revealed symptoms characteristic of myxedema, salivary gland hypertrophy, and an abnormal (hyper) production and secretion of mucin by the parotid glands.

Analyses of tissues of thyroidectomized monkeys demonstrated mucin to be present in the submaxillary glands in quantities of from 3.3 to 6.0 parts/1000 parts of tissue, while the parotid gland showed from .72 to 1.7 parts of mucin/1000 parts of tissue. Normal values were found to be .01 and 0 respectively.

Horton, Kathleen, John Marrack, and Ivor Price, 1929. THE RELATION OF CALCIUM IN THE SALIVA TO DENTAL CARIES. *Biochem. Jour.*, 23 (5): 1075-1078.

"Dental caries is associated with a reduction of the concentration of calcium in saliva. This reduction appears to be secondary to the caries." (Author's summary.)

Horwitz, A., 1921. POSTOPERATIVE VERMINDERTE SPEICHELSEKRETION UND IHRE BEKÄMPFUNG [Postoperative decreased salivary secretion and its control]. *Arch. klin. Chir.*, 118: 788-793.

A normal healthy individual secretes about 250 to 800 g. of saliva daily. In postoperative patients, due to the reduced activity of the mucous and salivary glands, a strong sensation of thirst is noted. The problem is especially acute after anesthesia, or after surgery performed on the

thyroid or on the gastrointestinal tract when drinking is usually contraindicated. One cc. of 0.2% Cesol (Merck), a synthetic pyridine derivative, was administered subcutaneously to surgical patients. The thirst-relieving effect of one injection lasted for 5-6 hours. The effectiveness of this drug is due to the hyperemia produced in the salivary gland, thus stimulating its reduced function.

Hotta, G., 1905. EXPERIMENTELLE UNTERSUCHUNGEN ÜBER DIE INFEKTION VON HORNHAUTWUNDEN DURCH SPEICHEL [Experimental investigations on infection of corneal wounds by saliva]. *Klin. Monatsbl. f. Augenheilk.*, 43: 237-253.

Infection of the cornea, either by contact with saliva-contaminated objects (handkerchiefs, fingers, etc.) or by saliva droplets sprayed during operations, is discussed; a short review of the literature on the microbial inhabitants of saliva is presented.

Experimental studies on cats, rabbits, and mice showed that superficial wounds which fail to perforate the cornea are much more susceptible to infection than are those which perforate the layer, permitting the escape of aqueous humor and the concomitant cleansing of bacteria.

The importance of saliva droplets in disease transmission was demonstrated. In 7 tests, both without and with a face mask of various layers of muslin, the author slowly repeated the letters of the alphabet at distances of 25, 30, and 40 cm. from agar plates. Without the mask, bacterial colonies were abundant (24, 25, and 19); with one or two layers of muslin, colonies were reduced, but still evident; three layers of muslin removed all droplet spray.

Howe, Percy R., 1911. DIETETIC EFFECTS IN ORAL SECRETIONS. *Dental Cosmos*, 53 (1): 43-55.

A study of the local effects of food on oral fermentation over a 3 to 4 year period has shown that uncontaminated parotid saliva was almost invariably acid during periods of carbohydrate excesses in the diet.

Ten persons fed heavily on carbohydrates for several days were examined periodically. After one day the salivas were similar, clear, bluish in color, viscid, and almost always acid. These salivas showed the presence of an aldehyde and somewhat later the presence of an alcohol. The saliva of some individuals, when fed a protein diet with a very limited amount of carbohydrates, lost its acidity, showed no presence of lactic acid, became less clear, and contained mucin in solution. Tests for uric acid were inconclusive. The salivas became very rancid on standing, whereas those produced during the carbohydrate test remained sweet, and 3 months after collection gave a characteristic reaction of alcohol. The author concludes that oral characteristics can be changed at will by changing the character of the diet.

Howe, Percy R., 1911a. INDICATORS IN SALIVARY ANALYSIS. *Dental Cosmos*, 53 (3): 320-323.

Various indicators are given for titration of saliva to determine the acidity with accuracy.

Howe, Percy R., 1912. DEVICES AND VOLUMETRIC TESTS FOR SALIVARY ANALYSES. *Dental Cosmos*, 54 (4): 429-433.

Numerous tests have shown that saliva drawn directly from the parotid glands is decidedly acid while that from the submaxillary and sublingual glands is neutral, slightly alkaline, or slightly acid. A description is given of an apparatus to obtain uncontaminated saliva. Methods are given for determination of specific gravity, viscosity, phosphates, carbonates, sulfates, chlorides, and calcium in saliva.

Howe, Percy R., 1912a. THE ACCELERATING AND INHIBITING AGENTS IN THE ORAL SECRETIONS. *Dental Cosmos*, 54 (5): 567-575.

Experiments were conducted to measure the amounts of acid produced by oral bacteria contained in saliva samples to which were added various sugars, and various phosphates or chlorides. In general the presence of the phosphates increased the rate and amount of acid formation, while chlorides depressed this activity. However, the ammonium ion augmented the activity in both phosphates and chlorides.

The alkalinity produced by dibasic sodium phosphate is considered not to be the principal reason for the increased acid production. Tests, in which the solutions were made alkaline by use of sodium carbonate, showed no acid production until active fermentation was initiated by addition of dibasic sodium phosphate. Addition of potassium thiocyanate to saliva-dextrin mixtures was also found to augment acid formation.

Howe, Percy R., 1913. THE SALIVA. *Dental Cosmos*, 55 (11): 1112-1117.

Literature on saliva is reviewed, and a general discussion given of the biochemical properties of saliva and their relation to systemic diseases.

Howe, Percy R., 1913a. EXPERIMENTS SHOWING THE EXCRETION OF MEDICINAL SUBSTANCES THROUGH THE SALIVARY GLANDS. *Dental Cosmos*, 55 (1): 37-39.

Various halides, antiseptics, and iron preparations administered in gelatin capsules became evident in the saliva 20 minutes after being ingested and continued to be present up to 9 hours afterward. Under such circumstances the salivary apparatus becomes an eliminating organ.

Howitt, Beatrice F., W. C. Fleming, and R. V. Simonton, 1928. A STUDY OF THE EFFECTS UPON THE HYGIENE AND MICROBIOLOGY OF THE MOUTH OF VARIOUS DIETS, WITHOUT AND WITH THE USE OF A TOOTHBRUSH. *Dental Cosmos*, 70 (6): 575-588.

Seven different diets (normal prison, "sticky," carbohydrate, first and second detergent, normal balanced, and liquid through a stomach tube) were fed, over periods of one week each, to a prison inmate whose teeth were free of dental caries and whose gum tissues seemed normal. The teeth and gums were cleaned thoroughly between each week's test. The study extended over a 15-week period because of repetitions for checking purposes or in order to study the diet both without and with the use of a toothbrush.

Debris gathered from the necks of certain teeth was diluted with sterile physiological saline solution and plated out on several different kinds of media to obtain the bacterial counts. The necessity for great dilutions of the material left only these organisms which predominated in large numbers as the normal flora of the

mouth. Only about 10 different types of organisms were found: streptococci (making up the bulk of the count), staphylococci, Gram-negative diplococci, other cocci, Gram-positive and Gram-negative threads, some spiral forms, and *Endamoeba gingivalis*. No spore-forming anaerobes were found. These bacterial counts, according to the diet being fed, are given in Tables II and III. Correlation between percentages of different organisms and kind of diet could not be drawn because of lack of uniformity.

Cleaning of the teeth by a brush brought about a noticeable lessening of the total number of organisms. The detergent diets, contrary to expectations, were not nearly as effective as a toothbrush in reducing the count of organisms present, and were less effective than several other diets. There was slight increase of aciduric forms with the carbohydrate diet. When the diet was given by stomach tube and the toothbrush was not used, debris, but in smaller amount than with food by mouth, was found in the mouth. This was shown by microscopic examination to be a mass of desquamated epithelial cells. One of the highest counts of organisms was found after the first tube feeding.

Howitt, Beatrice F., and Willard C. Fleming, 1930. A QUANTITATIVE EXAMINATION OF THE MOUTH FLORA UNDER DIFFERENT DIETARY CONDITIONS. *Jour. dental Res.*, 10 (1): 33-94.

Examinations of the oral floras of male prisoners, on various controlled diets, showed:

"1. There was a certain uniformity in the amount of dental debris obtained from each individual and also from the individuals classed according to mouth conditions, these amounts following the groups as to whether the men had normal mouths, or medium or advanced pyorrhea alveolaris.

"2. A change of diet did not appreciably alter the average amount of material from each individual.

"3. The average number of organisms per mg. from aerobic and anaerobic agar-plates having a pH of 7.4 averaged about the same for all the men on all the diets, except for more irregularity in the amounts from the normal controls. The total bacterial counts from the anaerobic acid (pH 4.8-5.0) agar-plates, however, were much lower than from the other two media. But in contrasting the number per mg. on the different diets, it is seen that the average amounts were greater for the men on the carbohydrate fare than on the protein. For the men of Group I [3 with normal mouths, 2 with medium pyorrhea, and 2 with advanced pyorrhea] the aciduric organisms were from four to six times as numerous on the former diet as on the latter [10 men with pyorrhea and varying degrees of bone resorption].

"4. Streptococci far outnumbered all other bacterial species in either of the pH 7.4 media, both relatively and absolutely. Alpha or green-producing streptococci were predominant, averaging 71.2 percent of all the aerobic organisms. Gamma types were 1.4 percent; beta, only 0.13 percent.

"The alpha streptococci were divided into several sub-groups. *S. salivarius* ... *S. mitis*... showed the highest percentages, with a smaller number of inulin fermenters and of non-lactose fermenters. The few beta forms were strains of *S. equi* and *S. pyogenes*.

"5. The principal organisms isolated from the extremely acid agar (pH 4.8-5.0) were members of the *Lactobacillus* group, with a smaller percentage of streptococci and of slender thread forms. The aciduric rods were a heterogeneous group that could be differentiated into several different strains by their carbohydrate reactions.

"6. No sporulating anaerobes were isolated, although spore-forming aerobes were occasionally present.

"7. The salivary pH remained fairly constant for the individual and did not seem to vary appreciably with the diet, the average value for all the men on both diets being pH 7.2-7.4. The salivary pH did not follow that of the urine, which was noticeably lower on the protein diet (average 5.7) and correspondingly higher on the carbohydrate fare (average 6.4).

"8. Spirochetes were found on slides from all the men, with only a slight increase in percentage for the men on the protein diet. About twice as many of these organisms were found, however, from the men having pyorrhea as from those with normal mouths.

"9. The experimental evidence indicates that the oral bacteria are more influenced by the local food remains than by any general systemic effect produced by dietary changes." (Author's conclusions.)

Hubbell, Rebecca B., and Russell W. Bunting, 1932. CALCIUM AND PHOSPHORUS OF SALIVA IN RELATION TO DENTAL CARIES. *Jour. Nutr.*, 5 (6): 599-605.

The effect of dietary factors on the chemical composition of the salivas was studied in school children from 7 to 16 years of age. The home diet was supplemented by the daily addition of 1 qt. of milk and 2 oz. of tomato juice, with or without Viosterol. Paraffin-activated saliva, collected over a certain period of time, was analyzed for total solids, ash, calcium and phosphorus. The samples were dried in platinum dishes in an electric oven overnight to determine the total solids. The dried material was ashed in an electric muffle. The ash was dissolved with hot HCl. Determinations of calcium and phosphorus were made on this acid ash solution.

In 275 determinations made on children who were free of caries, an average of 5.4 mg. calcium and 13.3 mg. phosphorus per 100 cc. of saliva were found.

The authors conclude that while there was no constancy of calcium or phosphorus content of saliva and no consistent variation with changes in tooth condition or with diet supplements used, it has become evident that the volume of saliva secreted in a given time should be considered. The average flow for these children was 1 cc./min. At the present, no satisfactory correlation between the rate of flow and tooth preservation can be made, although there appears to be a slight tendency for caries-free individuals to secrete larger volumes of saliva than for those with active caries.

Hubbell, Rebecca B., 1933. THE CHEMICAL COMPOSITION OF SALIVA AND BLOOD SERUM OF CHILDREN IN RELATION TO DENTAL CARIES. *Amer. Jour. Physiol.*, 105 (2): 436-442.

A report is made of data on 15 caries-free children from a group of 32, aged 9-16 years,

who were studied for a comparison of dental conditions, bacteriology of the saliva, and chemistry of saliva and blood. During the 18 months of the study, 6 paraffin-activated salivary samples were collected from each child, the samples being obtained at 7:00 in the morning, and again 3 hours after breakfast.

The average results of the analyses for the 15 children (with an average age of 11 yrs., 8 mos.) were: rate of salivation, 1.2 cc./min.; pH, 7.3. Constituents per 100 cc. of saliva were: total solids, 516 mg.; ash, 210 mg.; calcium, 5.4 mg.; phosphorus, 14.7 mg.; chloride, 44.9 mg.; titratable alkalinity, 114.0 cc. of 0.02N HCl; carbon dioxide capacity, 31.0 cc. Diastase converted an average of 24.0% soluble starch by Meyer's (1918) method. *Bacillus acidophilus* [*Lactobacillus a.*] was found consistently low or negative in the saliva of children free of dental caries.

Hübener, W., 1898. UEBER DIE MÖGLICHKEIT DER WUNDINFECTION VOM MUNDE AUS UND IHRE VERHÜTUNG DURCH OPERATIONSMASKEN [On the possibility of wound infection by way of the mouth and its prevention by surgical masks]. *Zeitschr. f. Hyg. u. Infektionskrankh.*, 28 (3): 348-372.

Wound infection during surgery was traced to bacteria expelled from the mouths of operating personnel by speaking, sneezing, or coughing. Moreover, the number of organisms expelled by speaking varied directly with the strength of the speaking voice (when speaking loudly, the numbers were far greater than when whispering). The greater part of the paper deals with an evaluation of the efficiency of various surgical masks.

Hufstader, Robert D., V. J. Anderson, and M. L. Snyder, 1950. EFFECT OF A SELECTED NITROFURAN, FURACIN, ON THE ORAL LACTOBACILLUS COUNT. *Jour. dent. Res.*, 29 (6): 794-797.

The effect of Furacin on oral lactobacilli was tested during three 10-day phases of no gum-chewing, chewing sugar-coated gum tablets for one hour three times daily, and finally chewing sugar-coated gum containing 100 mg. of Furacin per tablet. *Lactobacillus* counts of the salivas, collected before breakfast every three days during each test period, were made by the method of Hadley (1933m). The lactobacillus counts, which were significantly increased on chewing of the sugar-coated gum, were not significantly decreased by chewing the gum containing the Furacin.

Hug, E., and A. D. Marenzi, 1928. RÉACTIONS PARADOXALES DE QUELQUES SÉCRÉTIONS APRÈS UNE INJECTION ENDOVEINEUSE D'ACIDE [PARADOXICAL REACTIONS OF SOME SECRETIONS AFTER AN INTRAVENOUS INJECTION OF ACID]. *Compt. rend. de la Soc. de Biol. (Paris)*, 99 (21): 240-241.

The effects of intravenous injection of hydrochloric or of sulfuric acid (in concentrations up to normal) was studied in 21 dogs. Among body fluids tested, saliva was collected from Wharton's duct after chorda tympani stimulation. After injection of the acid, a slight increase in pH and a slight decrease in CO₂ content were noted in the saliva.

Hugenschmidt, Arthur C., 1896. EXPERIMENTAL STUDY OF THE DIFFERENT MODES OF PROTECTION OF THE ORAL CAVITY AGAINST PATHOGENIC BACTERIA. *Dental Cosmos*, 38 (10): 797-815.

The bactericidal properties of human saliva were tested on cultures of Staphylococcus aureus [Micrococcus pyogenes var. aureus], Sarcina, Torula, a streptococcus, and cholera vibrios [Vibrio comma]. The saliva collected on rising was filtered either through a Chamberland filter or common filter paper, seeded with the organism by loop or point and transferred to gelatin immediately and at regular intervals while incubating at 37°C. The sarcina, vibrio, and streptococcus developed equally well in heated (60°C for 1 hour) or unheated saliva. A slight inhibiting action of non-heated saliva on Torula was noted which was more pronounced in heated saliva. The action of saliva on Staphylococcus aureus was found to be somewhat greater than on the preceding organisms again with heated saliva appearing to be more bactericidal. The author concludes that although saliva is not important for its germicidal properties, it does dilute bacteria and alimentary particles to prevent stagnation in the oral cavity.

Experiments were conducted using 0.06, 0.10, and 0.20 to 1000 solutions of potassium thiocyanate, seeded with either a staphylococcus culture, or typhoid fever bacilli [Salmonella typhosa]. Liquid gelatin seeded from these suspensions and used to test growth at 37°C up to 24 hours showed no bactericidal effects attributable to the thiocyanate.

In another series of experiments designed to test the attractive power of saliva to leukocytes, capillary tubes containing human saliva were found to have dense leukocyte plugs after insertion for 8 hours in a mouse or guinea pig peritoneal cavity. A large plug was observed in a like experiment using saliva incubated 24 hours at 37°C. Another experiment using guinea pig saliva, observed to contain bacteria, gave similar results after 10 hours insertion into the guinea pig peritoneum.

Control experiments using filtered human saliva, physiological solutions, and a cholera culture showed no trace of phagocytes in the physiological solution, very few in the saliva, and a dense plug in the cholera culture tubes.

Guinea pig leukocytes mixed with human or guinea pig saliva, and incubated for 1 and 2 hours respectively, showed englobement of microbes. The author concludes that saliva attracts leukocytes which are capable of absorbing the oral bacteria present. Phagocytic activity was observed in a wound produced artificially in the mouth, both for the normal flora and for introduced streptococci. Desquamation of oral epithelium and vital antagonism of bacterial species are considered other defense mechanisms of the mouth.

Hulin, Ch., 1928. SUR L'ORIGINE ET LA FORMATION DES CALCULS SALIVAIRES (TARTRE DENTAIRE) [On the origin and formation of salivary calculi (dental tartar)]. Compt. rend. de la Soc. de Biol. (Paris), 98 (3): 185-186.

The author considers the stratified structure of salivary calculi to arise from a calcification of an albuminous substrate having the properties of a colloidal gel. This substrate results from an increase of organic albumins (derived from mucin, fibrin, and desquamated and migratory cells) by oral bacteria. The role of alkaline salts in the formation of insoluble calcium phosphates is discussed.

Hunt, George E., 1904. THE INHIBITION OF DENTAL CARIES. Dental Cosmos, 46 (10): 818-827.

Nutrient gelatin and agar cultures were made of a distilled-water mouth rinse, performed 5 minutes after and 1 hour after rinsing the teeth of 2 subjects with various test solutions being tested for germicidal action. Considerable day-to-day variation was found in the bacterial count, attributed to differences in oral secretions and bacterial flora. In general, Thiersch's solution (full strength), formalin (1:200), and salicylic acid (1:200) are considered ineffective; benzoic acid (1:200), fair; and mercuric chloride (1:3000 and 1:2500), alone or in combination with salicylic acid or other drugs, to give the best results.

Hurynowicz, Jeanne, 1928. ETUDE QUANTITATIVE DE L'ACTION DE LA NICOTINE SUR LE SYSTÈME ITÉRATIF CORDE DU TYMPAN-GLANDE SOUS-MAXILLAIRE [A quantitative study of the effect of nicotine on the chorda tympani-submaxillary gland system]. Compt. rend. de la Soc. de Biol. (Paris), 98 (6): 422-424.

The effects of nicotine on the chorda tympani and on the submaxillary gland were studied in three series of experiments. (1) intravenous administration of a strong or weak dose of nicotine reduced the excitability of the chorda tympani and soon afterward induced increased salivation but did not permit the separation of these two effects. (2) Local application of a weak solution to the exposed chorda tympani caused a temporary drop in irritability. (3) Similar application of a nicotine solution on the well-isolated submaxillary gland did not change the excitability of the chorda tympani.

Hyden, Glen, and J. Heim, 1953. A PRELIMINARY REPORT ON THE EFFECTS OF UREA AND CHLOROPHYLL ON THE RESPIRATION OF SALIVA AND A METHOD FOR EVALUATING VARIOUS SAMPLES OF CHLOROPHYLL. Jour. Dental Res., 32 (5): 653.

"The respiration of saliva and the effects of various compound on this respiration were studied by means of the Warburg technic. There are great differences in the rate of endogenous respiration of different samples of saliva. Further, the same sample of saliva changes its respiratory activity with the time and temperature at which it is kept. These variables make it difficult to compare results of work done at different times. After investigating the variations in respiration of different samples of saliva, the effects of urea and chlorophyll, in various concentrations and in combination at an effective concentration separately, on the endogenous respiration were studied. The effect of the compounds on the total endogenous respiration is expressed as the percentage of the control for a particular run, as a function of time. Then the effect of the compounds on endogenous respiration is expressed as the percentage of the rate of respiration of the control as a function of time. Both chlorophyll and urea, at appropriate concentrations, decrease the endogenous respiration. The combined effect of urea and chlorophyll shows that separate reactions in the respiration appear to be inhibited by the two compounds. Applying the same methods to various samples of chlorophyll, we find that, at the same concentrations, different samples of chlorophyll have different degrees of effectiveness in the inhibition of the endogenous

respiration of saliva. This provides an additional method for determining the activity of various samples of chlorophyll. (Author's abstract)

Hymanson, A., and H. Davidsohn, 1923. THE SALIVA OF THE NURSING. Amer. Jour. Dis. Child., 25 (4): 302-309.

A qualitative and quantitative study was made of the salivas of nurslings. One hundred electro-metric and colorimetric determinations of the salivas of 55 subjects showed the pH range to be 6.8 to 7.8, and probably between 7 to 7.8. The amount of saliva per 15 minutes ranged from 1.3 to 2.2 cc. (average 1.6 cc.) in the 1 1/2-3 month old infant, and from 2.5 to 8 cc. (average 4.8 cc.) in the 5-8 1/2 old infant. Deviation from normal flow was noted in 3 of 12 sick nurslings: two, aged 6 1/2 months with whooping cough and bronchitis, secreted 1.5 cc.; one, aged 5 months with glossitis, secreted 10 cc. Among 16 severely-infected nurslings, all but one, a 2 1/2-month nursling with bronchitis who secreted 1.6 cc., showed a variable but generally lessened salivation; in two cases of influenza no saliva could be obtained. In 19 cases of chronic disturbances, a similar diminution in salivation was noted, though to a lesser degree than among cases of acute and severe infections.

Ten investigations of the diastase content of saliva in nurslings aged 1 1/2 to 3 months showed an average range of 300 to 600 units, average 475, with two exceptions showing extremes of 50 and 1200 units respectively. In 21 investigations of healthy nurslings aged 5 to 8 1/2 months, the diastase content was generally between 600 and 1600, with two exceptions showing 100 and 4800 respectively. The diastatic content for diseased nurslings was generally normal; a drop was noted in 6 of 14 severely-infected infants. Among 11 cases of acute nutritional disturbances, 9 showed no reduction, one lacked saliva, and one who had an acute attack of dyspepsia 2 weeks previously, had a ferment strength of 50 units. No relationship between ferment strength and reduction of salivation was apparent in this series. A marked diminution in ferment strength was noted in 7 of 19 cases of chronic nutritional disturbance; in 5, this decrease was associated with a drop in salivation. In 8, there appeared to be no relationship, the ferment content being normal with a diminished quantity of saliva.

Iâkovleva, E. A., 1944. O SOOTNOSHENII MEZH DU VELICHINOI PERIFERICHESKOI KHONAKSII I SOSTOIANIEM VOZBUDIMOSTI PISHCHEVOGO TSENTRA PRI USLOVNOREFLEKTORNOI DEIATEL'NOSTI [On the correlation between the magnitude of peripheral chronaxy and the excitability of the brain's alimentary center in conditioned reflex activity]. Trudy Fiziol. Lab. I. P. Pavlova, 11: 134-138.

A chronaxic study of the dog on a starvation diet indicates that reduction of food to one half the regular amount results in an increased chronaxy in response to food stimuli as well as in an increased conditioned salivation.

In the case of a liberal or abundant diet, the effect is reverse, both chronaxy and conditioned salivation showing a sharp decrease.

When the conditioning experiment is transferred from the early morning to the normal feeding time of the dog, i.e. 4 hours later, the chronaxy increases abruptly.

When the dog has been kept on a reduced diet for one day only there is no considerable change either in chronaxy or conditioned salivation.

Iâroslavtseva, O. P., 1949. O PISHCHEVOM VOZBUZHDENII I SUMMATIONNOM REFLEKSE [On food stimulation and the summation reflex]. Trudy fiziol. Lab. I. P. Pavlova, 15: 17-22.

The mechanism of the summation reflex during nervous food activity was studied in the dog. Indifferent stimuli eliciting no salivary secretion were applied during feedings with moistened meat-rusk powder.

Results obtained showed that a determined environment in which an animal is fed becomes a stimulating factor, eliciting a general food reaction. In the presence of general food stimulation, every indifferent stimulus which has ceased to induce a strong orientation reflex, may induce motor and secretory food reactions. The indifferent stimulus after multiple application without reinforcement, acquires the properties of an inhibitory stimulant.

Iâroslavtseva, O. P., 1949a. IZMENENIE V KHODE BEZUSLOVNOGO SLIUNOOTDELENIIA POD VLIANIEM USLOVNYKH RAZDRAZHITELEI [Changes in the rate of unconditioned salivary secretion under the influence of conditioned stimulation]. Trudy fiziol. Lab. I. P. Pavlova, 15: 23-29.

The effect of prior conditioned stimulation on unconditioned salivary response to meat-rusk powder was studied over a 3-year period in a dog with a very regular unconditioned salivation. Unconditioned salivary response to the food was always lesser during the first 30 seconds than during the second; secretion increased gradually and attained a maximum toward the end of the feeding. Application of weak conditioned stimulation prior to food stimulation produced an increase in the initial rate of flow while application of strong conditioned stimulation usually caused salivation in the first 30 seconds to exceed that of the second. The subsequent food-stimulated salivation continued at an increased rate of flow during the eating. The enhanced unconditioned salivary response was directly dependent upon the strength of the prior conditioned stimulation. The interval between application of the conditioned and the unconditioned stimulation also affected the food-stimulated salivation. A minimum interval of 20 seconds was required to obtain the increased salivary response; maximum effect was obtained with a 30-60 second interval, while no effect was seen at intervals exceeding 3 minutes. The cerebral cortex is considered to affect unconditioned salivary response to food, a cortical reflex having a higher initial salivation rate, and subcortical reflex having a higher secretion rate toward the end of feeding.

Ignatius, A., 1936. UBER ANTIBAKTERIELLE HEMMUNGSTOFFE (INHIBINE) IM SCHLEIMIGEN NASEN-SEKRET [On the antibacterial inhibitory substances (Inhibines) in mucous nasal secretion]. Zeitschr. Hyg. u. Infektionskrank., 118 (4): 445-454.

A short review is presented of the literature on the antibacterial activity of saliva and of nasal secretions. Preliminary experiments show this activity in saliva to be independent of microbial activity. Saliva-agar plates with abundant growth of salivary organisms showed less antibacterial properties than did fresh saliva

plates. Inhibines active against endogenous and exogenous bacteria, were found in the secretions of healthy nasal mucosa; the watery nasal secretions of acute colds showed no antibacterial activity. Tests showed the inhibines to be identical with those of Dold (1936m) and different from lysozyme.

Inouye, J. M., S. Forer, M. G. Reische, and E. G. Miller, Jr., 1927. THE MUCINATE CONTENT OF SALIVA. *Proc. Soc. exper. Biol. Med.*, 25 (2): 153-155.

Twenty-five samples of saliva, stimulated by use of lime juice, rock candy crystals, smoking, and other stimulants, were obtained from 9 males, 20 minutes after collection of paraffin-stimulated control samples. The method of mucinate analysis is described.

The mucinate content of the saliva varied from 0.21% to 0.60%; average 0.27%, probable error 0.05. Excluding one sample which appeared to have an abnormally high mucin content of 0.60%, 25 of the samples ranged from 0.21% to 0.29%; average 0.26%, probable error 0.02, which may be taken as the normal mucinate content of saliva. The mucinate content of a given individual had a maximum variation of 0.08%.

The type of stimulant affected the salivary mucinate content. Lime juice produced a decrease in mucinate in each of 6 cases, up to 0.10% in 4 cases. Cigarette smoking caused no consistent change in the 3 cases studied. Rock candy particles evoked saliva with a consistently diminished mucinate content in 7 tests; this finding is not in contradiction to the observed increase in the mucinous quality of saliva evolved after intake of large amounts of sugar.

The total nitrogen content, determined in many cases as a partial check on results, varied similarly to the mucinate content in manner and magnitude of change under varying stimuli. The mucin content values were confirmed on the assumption that the protein present was mainly mucinate.

Inouye, James M., and Edgar G. Miller, 1928. SALIVARY MUCIN AND SOME OF ITS ORAL RELATIONSHIPS. *Jour. Dental Res.*, 8 (3): 450-451.

Analysis of 52 paraffin-stimulated samples of saliva from 18 "average" adult male subjects showed an average mucinate content of 0.27% (Calculated as Na mucinate), with approbable error for the series of 0.06. Only five samples were below 0.15 percent and two above 0.41. The range was between 0.08 to 0.37 percent. In general, the variation in the same persons on different days was as great as between individuals. Twenty-one samples, collected from eight subjects without any mechanical or chemical stimulation, gave an average value of 0.25 percent, with a probable error of 0.06, essentially the same result as that following paraffin chewing.

Accumulation of samples under lime-juice stimulation, 20 minutes after a paraffin-stimulated collection, gave a decrease in mucinate content in each of six cases (the decrease amounting in four cases to as much as 0.10 percent). This accords with the frequent observation of a "watery" saliva after acid stimulation, perhaps due to increased parotid activity. In 3 cases, cigarette smoking induced no consistent change in mucinate content. In seven tests, in which small amounts of sugar ("rock candy") were used

after controls, there was a consistent decrease in the mucinate content. The maximum fall was not determined, in four cases the dilution having made the nephelometric comparison unreliable. As this result followed stimulation by small amounts of sugar, it does not contradict the common observation of an increase in the mucigenous quality of saliva through the local action of large amounts of sugar.

As a partial check on the results, the total nitrogen content of cleared and dialyzed saliva was determined in many cases. The values obtained showed the same trend and magnitude of change under different stimulations, and corroborated the values for mucin content, assuming that the protein present was largely mucinate. (From author's abstract)

Inouye, James M., 1930. BIOCHEMICAL STUDIES OF SALIVARY MUCIN. *Jour. dental Res.*, 10 (1): 7-21.

A brief review of previous work on salivary mucin and mucinate is presented.

Salivary mucinate was extracted from unstimulated and stimulated salivas. 62 samples of paraffin-stimulated salivas from 27 subjects showed the following properties: average mucinate content (calculated as Na mucin), 0.27% probable error, 0.06%; range, 0.08% to 0.60%. Values for 53 samples of unstimulated saliva from 33 subjects were: average mucinate content, 0.25%; probable error, 0.06%.

The effect of various stimulants upon the salivary mucinate content was studied. 20 tests employing rock candy as a stimulant showed a consistent decrease in mucinate content; a series of 6 experiments using lime-juice stimulation 20 minutes after paraffin stimulation gave a decrease in each of the cases (the decrease amounting to as much as half the control amount in 4 cases); no consistent change was observed in a series of 20 cases in which smoking was used as a stimulant.

"Mucinate in oral secretions, by retarding evaporation of water, normally counteracts tendencies to unphysiological desiccation of oral membranes and dental surfaces."

An empirical formula for the conversion of mucinate to mucin and for the resolution of precipitate mucin into soluble mucinate is suggested.

Irwin, M., and A. G. Leaver, 1956. USE OF THE ORCINOL-SULFURIC ACID REACTION IN THE POSITIVE IDENTIFICATION OF CERTAIN MONOSACCHARIDES FROM A SALIVARY MUCOID. *Nature*, 177 (4520): 1126.

Paper chromatographic methods permitted tentative identification of galactose and fucose as present in the hydrolysate of a mucoid fraction of human saliva. Eluates from portions of the chromatograms containing the two principal bands were treated with orcinol and sulfuric acid and the absorption curves of the solutions measured to obtain positive identification of the two sugars. One solution gave the typical absorption curve for galactose while the second gave the characteristic curve for fucose (maxima at 390 mμ and 500 mμ). These two sugars have been found in the hydrolysate of human blood group A substance.

Irwin, M., and A. G. Leaver, 1957. BIOCHEMICAL ANALYSIS OF HUMAN SALIVARY MUCIN. I. THE POSSIBILITY OF CHOLESTEROL IN MUCIN. *Jour. dent. Res.*, 36 (1): 100-103.

Whole human saliva, obtained from traps in saliva ejectors at a dental clinic, was collected immediately after a dental treatment, briefly refrigerated and then centrifuged for 30 minutes at 2300 rpm. The salivary pH was reduced to 2.65 by addition of glacial acetic acid before addition of acetone, equal in volume to the acidified saliva, and overnight refrigeration. The mucin thus precipitated was washed in acetone to remove acetic acid and air-dried at 37°C.; the mucin obtained varied from 0.20 to 0.41 gm./l. Tests (including that of Kazakova, 1942) of the dried mucin showed no evidence of cholesterol. Inconclusive test findings suggested the presence of about 1 mg. of a sterol, other than cholesterol, in the ethanol extract of 2.43 gm. of the dried mucin.

Isaacs, Raphael, and Arthur C. Danielian, 1927. MAINTENANCE OF LEUKOCYTE LEVEL AND CHANGES DURING IRRADIATION. A STUDY OF THE WHITE BLOOD CORPUSCLES APPEARING IN THE SALIVA AND THEIR RELATION TO THOSE IN THE BLOOD. *Amer. Jour. med. Sci.*; 174: 70-87.

"1. The present work is a quantitative and qualitative study of the leukocytes which appear in the saliva in health and certain diseases.

"2. The saliva, as it appears at the opening of the ducts, is practically free from leukocytes. The white cells are washed together from the mucous membranes, through which they have wandered.

"3. The average leukocyte count in the mixed saliva (in health) varies from 5 to 150 (rarely as high as 450) cells per cubic millimeter, the variations appearing during the course of the day, sometimes quite rapidly.

"4. The variations in the number of the leukocytes in the saliva accompanies the changes in the number of leukocytes in the blood, but the relation is most commonly a reciprocal one.

"5. When a 'digestive leukocytosis' fails to show in the blood it is sometimes evident in a great increase in the number of cells in the saliva.

"6. All types of white blood corpuscles, and probably blood platelets are found in the saliva, the number varying with the disease.

"7. Although the percentage of polymorphonuclear leukocytes bears much the same relation to the other cells in the normal saliva as in the blood, it may be comparatively increased in chronic lymphatic leukemia and similar diseases.

"8. When the cells are abundant in the saliva the majority are living, but when they are scanty a greater proportion may show no signs of life.

"9. The process of 'rigor mortis' of polymorphonuclear leukocytes is described. Some of its stages are suggestive of a reversal of the process of maturation of the myelocytes.

"10. The number of leukocytes in the saliva is greatly increased in chronic myelogenous leukemia, often more so when the count is moderate than when it is extremely high. After Roentgen ray treatment there appears to be a great elimination of leukocytes, most of them living, in the saliva.

"11. The presence of myelocytes and young polymorphonuclear leukocytes in the saliva suggests that when immature cells enter the blood stream they are eliminated as such, and do not mature in the peripheral circulation.

"12. The cells may be greatly increased in number in the saliva in lymphoblastoma. In

aleukemic lymphatic leukemia the number of leukocytes per cubic millimeter of the saliva may be greater than that of the blood, the low white blood cell count being associated with the increased rate of elimination. In Hodgkin's disease the elimination of lymphocytes and eosinophils in the saliva may be marked.

"13. When leukopenia is accompanied by increased elimination of leukocytes in the saliva, cell production is active, and Roentgen ray irradiation of lesions in the body is not contraindicated.

"14. It appears that we may have leukocytosis from increased production of leukocytes or from decreased elimination and leukopenia from decreased production or from increased elimination.

"15. The mucous membranes of the mouth, and probably other parts of the gastro-intestinal tract act as points of elimination of leukocytes, in the general regulatory mechanism which tends to keep the blood elements within certain numerical limits." (Authors' summary and conclusions.)

Ivy, A. C., B. H. Orndoff, A. Jacoby, and J. E. Whitlow, 1923. STUDIES OF THE EFFECT OF X-RAYS ON GLANDULAR ACTIVITY. *Jour. Radiol.*, 4 (6): 189-199.

A detailed discussion and several tabulations are presented of the effects of various dosages of X-rays on the immediate and delayed secretory, sensitization, blood volume flow, and histological aspects of the submaxillary glands under acute and chronic experimental conditions. Also included is a critical review of literature pertaining to the effects of X-rays on the adrenals, kidneys, pancreas, hypophysis, thymus, gonads, spleen, and lymph glands.

Ivy, A. C., 1935. GASTRO-INTESTINAL PRINCIPLES EXCEPTING THOSE HAVING ANTIANEMIC AND CIRCULATORY EFFECTS. *Jour. Amer. med. Assoc.*, 105 (7): 506-509.

The introduction of extracts of the buccal and pharyngeal mucosae, or of dilute acid (in the case of a denervated submaxillary gland) failed to induce saliva secretion, and eliminated the possibility of the existence of a secretion-stimulating hormone in the salivary glands.

Jackson, Sterling W., and N. B. Williams, 1953. A PRELIMINARY REPORT ON THE EFFECTS OF ETHYLENE OXIDE ON SALIVA. *Jour. Dental Res.*, 32 (5): 656.

Ethylene oxide was added to freshly-collected, human, stimulated saliva to determine if the oxide would effectively sterilize the pooled saliva without having detrimental effects on certain other salivary components as amylase. The saliva and all equipment employed was thoroughly chilled to about 5°C. The chemical was added to the saliva, and the tubes were placed at 5°C. for one hour, then overnight at 37°C. Sterility tests were made by inoculating duplicate sets of blood agar plates, chocolate agar plates, and tubes of brain-heart infusion broth. One set was incubated aerobically, the other anaerobically at 37°C for one week. Concentrations from 0.6 to 2.0 percent volume sterilized all samples of saliva. It was noted that the pH of the saliva was increased in direct proportion to the amount of chemical added, but not sufficiently to affect the tests for sterility. Tests for

amylolytic activity were made, in duplicate, before and after addition of ethylene oxide. Controls consisted of aliquots of the same pooled saliva to which no ethylene oxide was added. Amylolytic activity in the controls was practically eliminated, whereas about 80 percent of the activity remained in saliva treated with 0.6 and 0.8 percent by volume of ethylene oxide. Greater concentrations of the chemical reduced the amylolytic activity to a greater degree. The chemical seems to bind chloride ions since activity could be restored to some degree by appropriate replacement. (From Author's abstract)

Jackson, S. W., G. I. Baxter, W. J. Kimber, and N. B. Williams, 1958. MANOMETRIC STUDIES OF MICROORGANISMS IN HUMAN PAROTID SALIVAS. Jour. dent. Res., 37 (1): 51.

Culture work demonstrated that oral strains of *Monilia albicans* (A), *Aerobacter cloacae* (B), and *Streptococcus faecalis* (C) survived in human sterile parotid saliva, but an alpha streptococcus (D) and a homofermentative lactobacillus (E) did not. Manometric technics using a Warburg apparatus were applied to the study of O₂ uptake of washed, resting cells in samples of human sterile parotid saliva. All saliva was collected aseptically using parotid cups. The following mean values, in microliters of O₂ uptake per milligram of cell N, were taken from the respiration curves of each strain after 90 minutes at 35.0°C.:

	A	B	C	D	E
Saliva	64	28	3.0	4.0	2.1
Endogenous	52	10	0.84	1.6	0.75

At any given time the endogenous values were always less than the O₂ uptake of microbes in saliva. Microbes A and B show greater oxygen consumption than either C, D, or E, even though the values are different for each microbe. However, all levels are far below those expected for microbes metabolizing in an optimal environment. It is concluded that human sterile parotid saliva is not an optimal environment, but contains components which can be utilized in metabolism. (Author's abstract)

Jacobson, Marvin, and R. G. Kesel, 1949. SALIVARY AMMONIA AND ITS CORRELATION TO DENTAL CALCULUS. Jour. Dental Res., 28 (6): 646.

"In investigating a possible mechanism of dental calculus formation, the ammonia nitrogen developed from the supernatant liquid and the residue of centrifuged stagnating saliva over a nine-day incubation period was studied. One hundred two patients were used in this study. They were classified as to calculus present, calculus free, and periodontal diseased. Approximately 5 cc. was received in another sterile container. The first sample was used for the *Lactobacillus acidophilus* determination. The second sample was used for the ammonia determinations on the initial day and on the third, fifth, seventh, and ninth subsequent days. The residue was separated from the supernatant liquid by centrifugation at 3500 r.p.m. for twenty minutes. One cubic centimeter of the supernatant liquid was used for the determination and the drained sediment for the residue determination. The results show that the greatest concentration of ammonia nitrogen was found in the supernatant liquid. The periodontal

diseased group had the greatest concentration, the calculus free and the calculus present about the same concentration. It was shown that bacterial action was necessary for ammonia production. Statistically there was no difference in the ammonia production of the calculus-free group compared to that of the calculus-present group." (Authors' abstract)

Jacobson, Marvin, 1950. SALIVARY AMMONIA AND ITS CORRELATION TO DENTAL CALCULUS. III. THE FATE OF SALIVARY MUCIN, NONMUCIN, AND AMMONIA NITROGEN OVER A SEVENTY-TWO-HOUR INCUBATION PERIOD. Jour. dent. Res., 29 (3): 380-385.

Thirty-five ml. saliva samples were collected from three groups of eleven individuals, classified as calculus-present, calculus-free, and periodontal-diseased. Immediately after collection, and at 24-hour intervals during three days of incubation at 37°C., determinations were made of the salivary content in total nitrogen, nonmucin nitrogen, and ammonia nitrogen. Mucin nitrogen values were derived by subtracting nonmucin nitrogen from the total nitrogen values.

Mucin nitrogen declined in all groups as the saliva stagnated, from 14.9 mg. to 11.2 mg./100 cc. in 72 hours in salivary samples from periodontal-diseased, and from 11.6 to 9.0 mg. for the calculus-present and 10.4 to 9.7 mg./100 cc. for the calculus-free after 48 hours of incubation. The periodontal-diseased group showed a higher initial nonmucin nitrogen content (47.1 mg./100 cc.) than did the calculus-present (40.1 mg.) or the calculus-free (35.7 mg.). Production of nonmucin nitrogen followed the same order during the 72-hour incubation period; the nearly parallel values for the calculus present and free groups indicates that the rate and amounts in salivary samples of these individuals to be largely dependent upon the initial nonmucin nitrogen content.

The periodontal-diseased group also showed a higher initial ammonia nitrogen content (7.8 mg./100 cc.) than had the calculus-present (6.3 mg.) or the calculus-free (4.1 mg.), and produced the most during the incubation period. The calculus-free group salivary samples had more ammonia nitrogen at 72-hours (28.3 mg.) than had the calculus-present (27.1 mg.). The results show the stagnating saliva to decrease in mucin nitrogen and increase in nonmucin and ammonia nitrogen during the 72-hour period, the breakdown being most rapid in the periodontal-diseased samples. Calculus-present saliva contained a greater content of nonmucin and ammonia nitrogen, and formed these at a higher rate than calculus-free samples during incubation; a correlation between this factor and calculus formation in susceptible individuals is suggested.

Jacobson, Marvin, 1950a. SALIVARY AMMONIA AND ITS CORRELATION TO DENTAL CALCULUS. II. AMMONIA NITROGEN DEVELOPMENT FROM THE WASHED RESIDUE OF CENTRIFUGED SALIVA OVER A SEVENTY-TWO HOUR INCUBATION PERIOD. Jour. dent. Res., 29 (3): 375-379.

Determinations were made of the salivary lactobacillus count, and of the percentage and ammonia nitrogen content of the residue of salivary samples collected from 30 noncalculus-formers and from 30 calculus-formers. The *Lactobacillus acidophilus* counts were made of a first, 3-minute

sample, two or more such counts being averaged for each individual, and then 15 cc. samples collected two hours after a meal. The dry residue was measured in a one cc. portion while 10 cc. were centrifuged at 4000 rpm for 15 minutes and the residue thoroughly washed in saline. The ammonia nitrogen determinations were made immediately, and after 24, 48, and 72 hours of incubation at 37°C. The percentage of residue in the total sample weight showed no significant difference: 0.68 ± 0.025 for calculus-free residue, 0.66 ± 0.019 for calculus-present. The ammonia nitrogen values in mg./cc. of saliva after 0, 24, 48, and 72 hours of incubation were: for the calculus-free, 0, 0.017, 0.038, and 0.051; for the calculus-present, 0.020, 0.032, and 0.043 respectively. These differences are not significant. The calculus-present group showed, on the average, lower salivary lactobacillus counts.

Jacobson, Marvin, and R. G. Kesel, 1950b. SALIVARY AMMONIA AND ITS CORRELATION TO DENTAL CALCULUS. I. AMMONIA NITROGEN DEVELOPMENT FROM THE SUPERNATANT LIQUID AND THE RESIDUE OF CENTRIFUGED SALIVA DURING A NINE-DAY INCUBATION PERIOD. Jour. dent. Res., 29 (3): 364-374. [Advance abst.: SALIVARY AMMONIA AND ITS CORRELATION TO DENTAL CALCULUS. Jour. dent. Res., 28 (6): 646, 1949.]

One thousand and twenty ammonia nitrogen determinations were made of the supernatant fluid and residue of centrifuged stagnating saliva (over a nine-day incubation period) collected from 102 subjects who were classified as calculus present, calculus free, and periodontal diseased. A Lactobacillus acidophilus count was first made of a paraffin-stimulated, 5 cc. sample of the saliva, while the ammonia nitrogen determinations were made of the second 50 cc. sample in 10 cc. portions immediately, and on the third, fifth, seventh, and ninth subsequent day of incubation at 37 C. The supernatant, obtained by spinning a 10 cc. sample at 4000 rpm for 15 minutes, was found to contain most of the ammonia nitrogen, which showed significantly higher concentration in both supernatant and residue of saliva from the periodontal-diseased group than from the other two groups. Ammonia production in the supernatant from the latter two groups was about the same, the calculus-present group however showing a significantly higher loss of ammonia nitrogen than the calculus-free between the seventh and ninth days of incubation. The calculus-present group, which showed few or no carious lesions, resembled the caries-negative class of the calculus-free group as to ammonia nitrogen content during the first five days of incubation. While some correlation is apparent between calculus deposition and an increased ammonia nitrogen content, other factors may also contribute to such deposition in periodontal-diseased subjects. This group had few unfilled carious lesions, the agency tending to predispose to calculus formation also apparently tending to inhibit dental caries to some extent. Few or no L. acidophilus were found in periodontal-diseased saliva, which also had the highest ammonia nitrogen content, 45 mg./100 cc. on the fifth day of incubation, as well as the greatest amount of salivary sediment. Autoclaved salivary samples showed little ammonia nitrogen production. A relationship is suggested between few or no carious lesions,

a low L. acidophilus count, and a high ammonia nitrogen content of the saliva.

Jaeger, Edmond, 1921. ÉTUDE PHARMACODYNAMIQUE DE L'ADRENALONE. ACTION VASOCONSTRICTIVE ET RESPIRATOIRE; EFFETS SÉCRÉTOIRES [A pharmacodynamic study of adrenalone. Vasoconstrictive and respiratory action; secretory effects].

Adrenalone, like adrenaline, increases salivary secretion. Experiments on dogs in chloralose anesthesia, with or without atropinization, showed that adrenalone had similar, but more prolonged, effects on the circulatory and respiratory systems as did adrenaline. Among other effects noted, it increased salivary secretion.

Jay, Phillip, M. Crowley, and R. W. Bunting, 1932. THE RELATIONSHIP OF THE OCCURRENCE OF BACILLUS ACIDOPHILUS IN HUMANS TO SKIN SENSITIVITY AND SPECIFIC AGGLUTININS IN BLOOD SERUM. Jour. dent. Res., 12 (3): 429-430.

A comparative study is reported of caries-free and caries-susceptible children as to skin sensitivity to purified B. acidophilus [Lactobacillus a.] filtrate and the occurrence of B. acidophilus agglutinins in the blood. Both feces and saliva were cultured for this organism; counts were made in saliva. B. acidophilus count were very high in saliva of the susceptibles, the caries free counts were negative or extremely low. [From author's abstract]

Jay, Philip, Mary Crowley, Faith P. Hadley, and R. W. Bunting, 1933. BACTERIOLOGIC AND IMMUNOLOGIC STUDIES ON DENTAL CARIES. Jour. Amer. dent. Assoc., 20 (12): 2130-2148.

The occurrence of Bacillus acidophilus [Lactobacillus a.] in the saliva was studied in 36 children. In 23 of the children who were caries-free, B. acidophilus was found to be either entirely absent or only sporadically present throughout the 1-1/2 years of the study.

Failure resulted when attempts were made to implant B. acidophilus in the mouths of 5 caries-free children by feeding them acidophilus milk, which had been prepared with strains isolated from dental caries.

From the immunological investigations it was found that: "Bacillus acidophilus agglutinins can generally be demonstrated in the blood serums of caries-free persons.

"The Bacillus acidophilus agglutinin titer of the blood serums of caries-susceptible patients was raised to the titer of caries-free persons by the administration of a vaccine containing the R phase of B. acidophilus. Such a procedure was generally accompanied by abscess formation at the site of inoculation." (From the author's conclusions.)

Jay, Philip, Faith P. Hadley, R. W. Bunting, in cooperation with Martha Koehne, 1936m. OBSERVATIONS ON RELATIONSHIP OF LACTOBACILLUS ACIDOPHILUS TO DENTAL CARIES IN CHILDREN DURING EXPERIMENTAL FEEDING OF CANDY. Jour. Amer. dent. Assoc., 23 (5): 846-851.

A direct correlation between candy intake, Lactobacillus acidophilus counts, and caries incidence was observed in 51 children studied over a 17-month period; in the first 12 months they

received no candy and in the last 5 unlimited amounts. During the latter 5 months, 23 (44%) showed evidence of active caries, a 31% increase over the incidence during the preceding year. 80% showed increased L. acidophilus counts.

Jay, Philip, and R. W. Bunting, 1937. EFFECTS OF LOW-SUGAR DIETS ON ORAL LACTOBACILLUS ACIDOPHILUS. Jour. dent. Res., 16 (4): 315-316.

"Caries tends to increase with excess of carbohydrate in otherwise adequate diets. Not due to disturbance of nutritional balance of diet, but rather to proliferation of Lactobacilli in mouth, caused directly by high carbohydrate intake. Conversely, restriction of carbohydrate causes proportional decrease in numbers of lactobacilli in saliva. Extent to which growth of L. acidophilus in saliva may be influenced varies with individual and inherent susceptibility to dental caries. Addition of di-calcium phosphate and viosterol to unrestricted diets: no numerical effect on oral lactobacilli."

Jay, Philip, 1940. THE RÔLE OF SUGAR IN THE ETIOLOGY OF DENTAL CARIES. Jour. Amer. dent. Assoc., 27 (3): 393-396.

The paper deals with a review of the published literature on the relation of nutrition to the presence of Lactobacillus acidophilus in the mouth and the activity of caries.

The author followed the response of the lactobacillus counts in the saliva of patients to high and low carbohydrate intake. In some cases lactobacillus counts were reduced from approximately 500,000 to less than 5,000 per cubic centimeter of saliva within two weeks on a diet in which the carbohydrate intake was restricted to 51 g. daily.

Jay, Philip, 1947. THE REDUCTION OF ORAL LACTOBACILLUS ACIDOPHILUS COUNTS BY THE PERIODIC RESTRICTION OF CARBOHYDRATE. Amer. Jour. Orthodont. and Oral Surg., 33 (3), Oral Surg.: 162-184.

The restriction in diet of 809 persons having salivary lactobacillus counts exceeding 10,000 to a maximum carbohydrate intake of 100 gm. daily resulted in reduced lactobacilli counts in 83.4% of the individuals. The lactobacilli count remained low in 81.6% of 563 of these individuals when unrestricted starch was added after a 2-week period to the test diet. The low count continued in 73.4% of 313 of these persons on the addition of sugar at one meal. Tests of 127 of these last showed the counts continuing low on return to an unrestricted diet. It is suggested that an oral bacterial flora antagonistic to lactobacilli may be produced by a carbohydrate restriction in the diet.

Jeangros, J., 1928. UNTERSUCHUNGEN ÜBER DIE PERMEABILITÄT DER ZELLEN. XIV. ZUR FRAGE DER AUSSCHIEDUNG DER ZUCKERARTEN DURCH DIE SPEICHELDRÜSEN [Permeability of cells. XIV. Secretion of various kinds of sugars by the salivary glands.] Biochem. Zeitschr., 200 (1-6): 367-378.

Pilocarpine was injected to stimulate the salivary secretion of rabbits. A few minutes later the following sugars in the amount of 10 to 60 cc., were then injected intravenously: grape sugar, saccharose, fructose, lactose, galactose, and maltose. Following pilocarpine injection

no overflow of sugars were noted in the saliva. No increase in normal salivary sugar content was seen when a 0.9% saline solution injected into the right aural vein induced hydremic plethora.

Jenkins, G. N., 1946. EFFECT OF MASTICATION ON THE ASCORBIC ACID CONTENT OF RAW VEGETABLES. Biochem. Jour., 40 (3): 415-419.

An investigation was made of the loss of ascorbic acid from foods during mastication. Subjects were instructed to chew, without swallowing, a determined quantity of raw or cooked (destroying ascorbic acid), shredded cabbage, watercress, or parsley, after which the material was recovered from the mouth and the ascorbic acid content determined by titration (Harris and Olliver), using 2:6-dichlorophenol-indophenol as an indicator. In vitro investigations were made of the rate of oxidation of ascorbic acid by ascorbic acid oxidase.

Ascorbic acid was lost from cooked and raw foods in similar amounts which indicated that the vegetable's ascorbic acid oxidase was not responsible for the reduction. An oxidizing substance (believed to be nitrite) was found in saliva which slowly oxidized ascorbic acid in acidified solution and which was enhanced by several salivary substances, e.g., potassium thiocyanate and creatinine, unable to produce oxidation themselves. Although acidified with gastric juice, normal saliva would not cause the oxidation of ascorbic acid, nor was there loss of the acid from drainage into the esophagus when voluntary inhibition of the swallowing reflex was practiced; insignificant amounts could have been lost through absorption from the oral mucosa or by oxidation in the stomach.

It was concluded that neither nitrite nor saliva, in neutral solutions (as in the oral cavity) accelerate the loss of ascorbic acid from vegetables unless the solution is made acid, e.g., as when metaphosphoric acid is added to the oral contents prior to titration analysis.

Jenkins, G. N., and I. Kleinberg, 1956. STUDIES ON THE pH OF PLAQUE IN INTERPROXIMAL AREAS AFTER EATING SWEETS AND STARCHY FOODS. Jour. dent. Res., 35 (6): 964.

The studies of Stephan (1940; and elsewhere) on the fall of pH in the plaque on the surfaces of teeth after glucose rinses have been extended. A modified type of antimony electrode has been used which reaches well into interproximal areas, and is shaped so that the same area is reached each time it is placed in position. Stephan's results, with 10 percent sugar solutions, were confirmed for interproximal areas. The pH of interproximal areas has been studied during and following the sucking of sweets and the eating of starchy foods under reasonably normal conditions. Measurements of salivary pH have also been made and the role of salivary pH in controlling that of the plaque has been assessed. The results, as a whole, tentatively suggest that during the consumption of these foods the pH drop is slow and the minimum pH is reached only after eating is finished. This delay in the pH drop is thought to be partly caused by the rise in pH of the saliva which occurs during the increased rate of flow resulting from the stimulus of eating. In addition, with sweets, the sugar in the mouth may reach sufficiently high concentrations to inhibit

bacterial acid production. In subjects whose interproximal spaces retained bread after eating, the pH remained at a low level for a considerably longer time than in the classical Stephan curve. If the bread was not retained in a particular area, the pH drop was almost negligible. (Author's abstract)

Johansen, Erling, 1953. DETERMINATION OF ORAL pH IN THE SYRIAN HAMSTER. *Jour. dent. Res.*, 32 (5): 702-703.

Microantimony electrode determinations were made of the pH of oral secretions and of certain areas of the molar teeth and surrounding soft tissues of 120 hamsters on stock diet and on caries-producing diet. No significant pH differences were found between the 2 dietary groups. The following pH values represent averages and ranges of 20 to 50 readings in each specific area: parotid duct opening, 9.0 (8.3 - 9.9); sublingual duct opening, 8.6 (8.1-9.4); palate, 8.5 (7.9 - 9.0); posterior to third molar, 8.1 (6.9-9.0). The following are values determined from animals on the caries-producing diet only: periodontal pockets, 8.5 (7.5 - 9.1); carious lesions with saliva in situ 7.5 (5.3-9.0; sound surfaces on carious teeth with excess saliva removed, 8.0 (6.8 - 8.7); the carious lesions on these teeth with excess saliva removed 6.5 (5.1 - 7.8). Check readings of the sublingual and parotid duct areas with a glass electrode gave readings slightly lower than the antimony electrode. Sublingual and palate readings were within 0.2, whereas the parotid results were within 0.5 pH unit. Readings on standard buffers were in good agreement with both electrodes. Appropriate indicators introduced into the oral cavity gave color changes in the areas studied, confirming the general range of pH values. (From author's abstract)

Johansen, Erling, and F. Brudevold, 1954. FURTHER OBSERVATIONS ON ORAL, SALIVARY, AND FECAL pH IN THE SYRIAN HAMSTER. *Jour. dent. Res.*, 33 (5): 710.

A report is made of salivary pH reading determined extraorally by deposition of capillary-tube samples of mixed, parotid, and sublingual salivas on a specially-designed glass electrode. Averages and ranges of 20 or more samples of these types of saliva were determined to be mixed, 8.6 (8.4-8.9); parotid duct opening, 8.7 (8.2-9.3); and sublingual, 8.7 (8.4-9.1). These data are in accord with earlier values previously announced for the hamster (Johansen, 1953). (From author's abstract)

Jenness, Arthur, and R. C. Hackman, 1938. SALIVARY SECRETION DURING HYPNOSIS. *Jour. exper. Psychol.*, 22 (1): 58-66.

A study was made of the effect of hypnosis on the unconditioned secretion from the parotid gland in male and female adult subjects. The secretogogic agent used in 7 hypnotizable and 3 control subjects was 1 cc. of lemon juice; during hypnosis the average secretion of saliva was found to be 40 percent less than that observed in the normal state. The factors influencing the decreased salivation in hypnotized subjects are discussed.

Jennison, Marshall W., 1941. THE DYNAMICS OF SNEEZING - STUDIES BY HIGH-SPEED PHOTOGRAPHY. *Scient. Monthly*, 52: 24-33.

A still or high-speed motion picture camera with stroboscopic lighting was used to photograph the sneezing action of 16 subjects (with and without hay-fever or colds). The sneezing reflex was initiated by rubbing snuff into the nostrils.

Most of the droplets, appearing on the photographic plates, seemed to originate from the saliva in the front of the mouth, and the largest particles or masses emerged from those subjects suffering from hay-fever or colds. The size of the sneeze-droplets was found to depend upon the extent of mouth closure as well as the anatomical approximation of the teeth. The distance of the sneeze particles and of their evaporation depended upon the velocity, moisture content of the particles, as well as the temperature and humidity of the surrounding atmosphere. Apparently, mouth droplets are very important for they are smaller and evaporate quickly while suspended by air currents.

The formation of droplets from salivary filaments is illustrated in several photographs.

Jennison, Marshall W., 1942. ATOMIZING OF MOUTH AND NOSE SECRETIONS INTO THE AIR AS REVEALED BY HIGH-SPEED PHOTOGRAPHY. *Publ. Amer. Assoc. Advancement Sci. (Aerobiology)*, No. 17: 106-128.

An extensive literature review and discussion is presented concerning the conditions of introduction of respiratory droplets into the air, as well as the physical characteristics and behavior of the droplets during and after expulsion.

Jensen, Aksel T., and M. Dan, 1954. CRYSTALLOGRAPHY OF DENTAL CALCULUS AND THE PRECIPITATION OF CERTAIN CALCIUM PHOSPHATES. *Jour. dent. Res.*, 33 (6): 741-750.

A study of the crystallography of 52 specimens of dental calculus shows 54% of the calculi from salivary glands to contain whitlockite; 80% of specimens of dental calculus show the presence of this calcium phosphate. This finding substantiates a hypothesis that saliva contains a factor inhibiting precipitation of apatite.

Johnson, Claud D., and E. W. Goodpasture, 1934. AN INVESTIGATION OF THE ETIOLOGY OF MUMPS. *Jour. exper. Med.*, 59 (1): 1-19.

Fresh saliva from 6 cases of mumps was injected through the duct of Stensen directly into the parotid gland of the *Macacus rhesus* monkey. An acute non-suppurative parotitis which was judged to be mumps was induced by 4 out of the 6 saliva samples. The infectious agent obtained from the saliva had the properties of a filterable, cytotropic virus. It was resistant to drying and glycerination and conferred immunity to reinoculation. The virus was not found in the saliva of 2 healthy individuals.

Johnson, Claud D., and E. W. Goodpasture, 1935. THE ETIOLOGY OF MUMPS. *Amer. Jour. Hyg.*, 21 (1): 46-57.

A report is given, with case briefs, of the inoculation of 17 children, aged 3 to 12, with mumps virus from the parotid glands of two infected *Macacus rhesus* monkeys. The virus, originally obtained from the saliva of a human mumps patient and then passed through a series of 11 monkeys, as a dilute emulsion of parotid tissue, was sprayed over the orifice of Wharton's duct and then applied to these orifices in sterilized

cotton plugs for 15 minutes. Following this treatment the nostrils were also sprayed, the procedure being repeated the following day. Four of the 17 cases, previously exposed during an epidemic of the disease and used as controls, showed no reaction to the inoculation. Of the 13 supposed susceptibles, 6 developed clinically positive cases of induced mumps, 3 had a doubtful mumps infection (no visible glandular swelling), and 4 showed no evidence of the disease. All positive and questionable cases were mild and free of complication. The saliva from a typical case was recovered and used to reproduce the experimental disease in monkeys.

Johnson, F. George, 1943. STUDIES ON GRAMICIDIN AND RELATED SUBSTANCES: BACTERICIDAL EFFECT OF TYROTHRIN ON ORAL BACTERIA. Jour. Amer. dent. Assoc., 30 (23): 1909-1914.

"A study of the bactericidal power of tyrothricin on oral bacteria has been carried out in vitro. Organisms used were isolated from specimens of saliva, from root canals and from periapical abscesses. The tyrothricin, in the presence of 10 percent glucose, was found to be effective against gram-positive organisms when its concentration was 0.06 mg. per cubic centimeter or greater. Its bactericidal action was usually at a maximum at the end of four hours. It had a tendency to be more effective against streptococci than against the other organisms tested. Whole saliva partially inhibited the bactericidal power of tyrothricin.

"At the concentration just mentioned, the action of tyrothricin inhibited the motility of spirochetes. A tenfold concentration was necessary for bacilli and vibrios.

"When tyrothricin was applied locally on mucous membranes, it was found to be non-toxic for guinea-pig and in one human case tested.

"Tyrothricin given intraperitoneally in the quantity of 0.015 mg. protected mice against 0.5 cc. of whole saliva given in the same manner. This dose was ineffective against 1 cc. of mixed saliva." (Author's summary.)

Johnston, Marion M., C. H. M. Williams, P. G. Anderson, T. G. H. Drake, F. F. Tisdall, and Mildred J. Kaake, 1936. LACTOBACILLUS ACIDOPHILUS IN DENTAL CARIES. Jour. Amer. dent. Assoc., 23 (8): 1493-1497.

Lactobacillus acidophilus counts were made on paraffin-stimulated saliva obtained from a selected group of 39 children over a period of 1 year. Both qualitative and quantitative methods were employed in determining the presence of L. acidophilus.

In a group of 27 children in which there was no evidence of progressive caries, Lactobacillus acidophilus was never found in the mouths of 18 (66%) of these children.

Estimations were also made of the more common microorganisms that appeared on the plates in addition to L. acidophilus. Yeasts, gram-positive cocci, Micrococcus tetragenus [Gaffkya tetragena], staphylococci, and streptococci were frequently found. The flora was observed to be very meager on the plates of many children whose L. acidophilus counts were continuously low or negative. It was felt that perhaps some inhibitory influence diminished all bacterial growth. However, an attempt to demonstrate an inhibitory substance

for L. acidophilus in saliva of persons who had no L. acidophilus and a low incidence of other forms failed.

No agglutinins or precipitins were found in any salivas examined.

Jolyet, , and Laffont, 1879. INNERVATION ET CIRCULATION DE LA GLANDE MOLLAIRE ET DES GLANDULES LABIALES CHEZ LE CHIEN. INNERVATION VASO-DILATATRICE DE LA JOUE ET DE LA LÈVRE INFÉRIEURE [Innervation and circulation of the molar and labial glands in the dog. Vasodilator innervation of the jaw and lower lip]. Compt. rend. Soc. Biol. (Paris), 31, Compt. rend. p., 303-305.

The buccal nerve contains vasodilator fibers to the lower lip and mucosa of the jaw as well as motor fibers to the molar and lower lip glands. Stimulation of the buccal nerve produces a very thick saliva from the molar gland and droplets of similar, but less viscid, saliva from the mucosa of the lower lip.

Jones, R. T., Jr., and V. F. Lisanti, 1954. HEXOKINASE ACTIVITY IN HUMAN SALIVA. Jour. dent. Res., 33 (5): 664-665.

The presence of hexokinase was determined in human salivary samples by determination of the rate of available reducing sugar to the phosphorylated form in the presence of A.T.P. and magnesium ions. A one ml. sample of saliva was incubated at 37°C with one ml. of a reaction mixture containing 7 M/1000 sugar, 7 M/1000 A.T.P., M/100 Mg Cl₂, and 6 M/100 "Tris" buffer at pH 8. Final reducing sugar concentrations were measured in a photocolormeter at 540 μ. A 3.3/1000 dilution of a partially purified hexokinase preparation, incubated 2 to 30 minutes, showed a disappearance respectively of 6 to 72% of the initial glucose concentration; a 6.7/1000 dilution after 40 minutes incubation showed a 49% disappearance. Whole saliva incubated for 5 to 60 minutes showed average glucose conversion of 11 to 56%. (From author's abstract)

Jonesco, Demètre, and V. Teodosio, 1929. PASSAGE DU VIRUS RABIQUE DANS LES GLANDES SOUS-MAXILLAIRES CHEZ LE CHIEN [Passage of rabies virus into the submaxillary gland in the dog]. Compt. rend. Soc. Biol. (Paris), 100: 897-898.

An emulsion of the salivary gland of the dog, which had previously been infected with rabies virus, was inoculated subdurally into the rabbit. The submaxillary gland was found virulent in 4 of ten cases seven days before the clinical symptoms of rabies became apparent in the dog, and 10 days before its death. In five of the remaining cases the glandular emulsion was non-virulent, and the glands having been excised more than 7 days before appearance of the clinical symptoms. One animal did not contract rabies.

Jonsgar, Signe, 1937. CALCIUM CONTENT OF STIMULATED AND UNSTIMULATED SALIVA. Jour. dent. Res., 16 (3): 173-177.

Experiments were made to determine the effects of different methods of saliva treatment on calcium content, in an attempt to substantiate or refute the divergent figures of previous authors for calcium content of saliva.

Saliva samples were collected, both of unstimulated saliva and of saliva stimulated by paraffin, by crystallized sugar (free of calcium),

by sand, or by acetic or citric acid. The calcium contents were determined in 32 cases by direct precipitation without ashing, and 20 cases after ashing. Both methods gave similar results.

In both test series, the calcium content changed with any type of stimulation. It decreased as the secretion rate of saliva increased. The calcium content of unstimulated saliva ranged from 3.3 to 6.9 mg./100 cc. of saliva; the calcium content of stimulated, excluding acid stimulation, was between 3.3 and 5.9 mg./100 cc. of saliva. High values of 15.8 and 18.4, which occurred in saliva stimulated by citric acid, were believed to be due to the dissolving of calculus deposits or tooth substance.

When one teaspoonful of "Kalfocit," a special bone preparation, was fed to 9 children, each day for one month, the calcium content of the salivas increased slightly. The average calcium content before administration of Kalfocit was 4.6 mg./100 cc. saliva; the average after Kalfocit, 5.0 mg./100 cc.

Joseph, Max, 1904. ÜBER DIE RHODANAUSSCHEIDUNG IM SPEICHEL SYPHILITISCHER. [On the secretion of rhodanide in the saliva of syphilitics] Arch. Dermatol. Syp., 70: (1) 49-66.

Determinations, made of the rhodanide content of the saliva of syphilitic patients, are distinguished as to age groups, sex, and smoking habits.

Jung, L., 1924. DE L'ACTION AMYLOLYTIQUE DE LA SALIVE DU CHIEN [On the amylolytic action of dog saliva]. Compt. rend. Soc. Biol. (Paris), 91 (27): 673-674.

The amylolytic action of saliva was studied in 30 dogs. Saliva isolated from the mouth or extracts of salivary glands (submaxillary, parotid), tested on a 2% starch suspension were found to be weak in amylolytic power (producing .009-.04 g. of maltose after 1 hr. while an identical test using pancreatic juice of the same dog produced 1.05-1.3 g.). Extracts of tonsils, and of buccal and pharyngeal mucosa had a nearly equivalent power to that of saliva and caused no increase in amylolysis when added to the saliva.

Mixed saliva evolved after pilocarpine stimulation and collected from the mouth or from an esophageal fistula, was found likewise to be very feeble in amylolytic power.

In a subsequent experiment dogs were fasted 24 hours then fed a meat broth with added bread and starch (50-100 g./liter). The stomach contents were recovered immediately after the meal and incubated for 1-24 hours.

In all cases starch conversion was found lacking immediately after recovery of the meal and lacking or very slight even after prolonged incubation. However, addition of 5 cc. of human saliva to a sample (which had .033 g. of sugar present before ingestion) and incubation for 1 hour at 37°C produced 5.08 g. of sugar.

Jung, Louis, 1925. DU RÔLE DE LA SALIVE CHEZ PRINCIPAUX ANIMAUX DOMESTIQUES [On the role of saliva in the principal domestic animals]. Compt. rend. Soc. Biol. (Paris), 93 (26): 526-528.

Comparison was made of the saccharifying power of the salivas of horse, bovine cattle, goat, pig, and rabbit, simultaneously collected from the mouth and an esophageal fistula, usually after pilocarpine stimulation.

In the horse, saliva collected from the mouth was limpid and had little saccharifying power, while that collected from the fistula was viscid and cloudy. The saliva collected from the fistula had little saccharifying power during the first 2 hours of incubation at 38°C but converted about a third of the starch after 24-48 hours of incubation. As extracts of the parotid, maxillary, and molar glands were completely inactive, the saccharifying power of the swallowed saliva was considered as possibly due to mucus or microbial action. The salivas of bovine cattle and goat were found to be practically without saccharifying power. Saliva from the mouth of the pig was found to have considerable power. Extracts from the salivary glands of the pig showed that the parotid saliva was more active than the submaxillary. Saliva from the mouth of the rabbit was found to be the most active of those tested, nearly equal to the saccharifying power of human saliva. The author concludes that in the pig and rabbit saliva can play a part in digestion but in the hoofed animals it has exclusively a mechanical role.

Jungebult, Claus W., 1935. OCCURRENCE OF POLIOCIDAL SUBSTANCES IN TEARS, SALIVA AND CEREBROSPINAL FLUID OF NORMAL INDIVIDUALS. Proc. Soc. exper. Biol. Med., 32 (9): 1534-1537.

A series of tests were made of the presence of poliocidal substances in human tears, saliva, and cerebrospinal fluid, in which 0.8 cc. of such fluids or their dilutions (1:2; 1:5; 1:20) were mixed with 0.2 cc. of a 10% suspension of poliomyelitis virus, incubated at 37.5°C for 1-1/2 hours and then refrigerated for 24 hours before intracerebral injection into monkeys. Pooled and filtered saliva from a group of 5 or 6 normal subjects was used in a series of 23 tests, four with undiluted saliva, fifteen with saliva diluted 1:2, three with saliva diluted 1:5, and one with saliva diluted 1:20. One monkey, inoculated with a 1:2 saliva-virus mixture, survived without paralytic symptoms. Three other monkeys developed poliomyelitis after 15 to 21 days; one of these had received undiluted saliva-virus, while two had been inoculated with a 1:2 saliva-virus mixture. All other monkeys developed typical poliomyelitis. No evidence is found for the presence of neutralizing substances in the saliva. In 11 tests using pooled tears from the same group of subjects, monkeys inoculated with undiluted mixtures showed no paralytic symptoms; varying degrees of paralysis occurred in the remainder of the tests with tears diluted. Three pools of normal human spinal fluid were tested for neutralizing properties; none deactivated the poliomyelitis virus. Tests, using the spinal fluid of six convalescent monkeys, showed one case of paralysis, occurring 28 days after inoculation, suggesting a slight inactivation of the virus; the other five gave no evidence of neutralizing substances in the spinal fluid.

Jungeblut, C. W., B. Horvath, and A. W. Knox, 1952. INHIBITION OF COL. -SK VIRUS HEMAGGLUTINATION BY HUMAN SALIVA. Arch. pediat., 69 (8): 321-324.

Human saliva was found to contain a factor which inhibits hemagglutination by the Columbia SK virus. Of the 40 salivary samples tested only one showed a marked degree of inhibition, a few

exerted a moderate amount of inhibition which varied irregularly over the experimental period, and the majority showed no positive effects whatever. The factor producing the greatest inhibitory effects was secured from a "non-secretor" of the A₂ blood group; however there is no correlation between the presence of the virus hemagglutination inhibitor and blood groups, sex, sample collection time, diet, smoking habits, menstruation, or pregnancy.

Of a group of 17 paralytic poliomyelitis patients studied, 12 produced saliva in which the inhibitory factor could be consistently detected.

Jungherr, Erwin, Roy E. Luginbuhl, and Lawrence Kilham, 1949. SEROLOGIC RELATIONS OF MUMPS AND NEWCASTLE DISEASE. *Science*, 110 (2857): 333-334.

In a serological study of an apparent close relationship between Newcastle disease and mumps virus, the mumps virus was isolated from the saliva or spinal fluid of 11 patients.

Junqueira, Luiz C., 1951. CYTOLOGICAL, CYTOCHEMICAL AND BIOCHEMICAL OBSERVATIONS ON SECRETING AND RESTING SALIVARY GLANDS. *Exper. Cell Res.*, 2 (3): 327-338.

A study was made of biological processes related to submaxillary gland secretion in adult, male, albino mice following unilateral ligation of Wharton's duct.

Atrophy of the affected gland began 2 or 3 days after the operation and reached its maximum during the 15-30 day post-operative period. Reduction in size of the tubular and acinar cells was accompanied by absence of secretory granules and diminution of mitochondria. Cytochemical tests showed the absence of tyrosine and protein-bound disulfide groups in these cells. Biochemical tests showed a sharp reduction in protease and amylase. The nuclei of these "resting" cells showed no apparent alteration. Repeated androgen stimulation of atrophied glands, ligated 15 days previously, resulted in partial reappearance of mitochondria and the presence of moderate amounts of secretory granules in the tubular portion of the gland.

Acid phosphatase, present in the nuclei and apical zone of the serous tubule of non-ligated (control) glands, was noted only in the nuclei of ligated gland cells. Basophilia dispelled by ribonuclease in the basal regions of the acini and serous tubules was present in controls, absent in ligated glands. Indophenol oxidase and succinic dehydrogenase was diminished in ligated cells as compared to control cells. No significant change in alkaline phosphatase was noted after duct ligation. It is suggested that acid phosphatase, indophenol oxidase, succinic dehydrogenase, and basophilia removable by ribonuclease probably play a part in submaxillary cell secretion. The ligated submaxillary gland appears to be a purer "resting gland" than those already studied.

Kabat, Elvin A., A. Bendich, A. E. Bezer, and S. M. Beiser, 1947. IMMUNOCHEMICAL STUDIES ON BLOOD GROUPS, IV. PREPARATION OF BLOOD GROUP A SUBSTANCES FROM HUMAN SOURCES AND A COMPARISON OF THEIR CHEMICAL AND IMMUNOCHEMICAL PROPERTIES WITH THOSE OF THE BLOOD GROUP A SUBSTANCE FROM HOG STOMACH. *Jour. exper. Med.*, 85 (6): 685-699.

Salivary samples, from 7 secretors of blood group A, were digested with pepsin and the alcohol-

precipitated digest purified by centrifugation, dialization and 90% phenol extraction. Both the phenol-insoluble fraction and the 10% ethanol precipitates of the phenol extract showed blood group A activity. No 10% precipitate was obtained from the water-soluble portion of a salivary sample purified without peptic digestion. Comparison of the analytic properties of these salivary preparations with those obtained in similar fashion from a sample of human amniotic fluid and the 10% precipitates from human stomachs showed the substances similar in nitrogen, glucosamine, reducing sugar, and acetyl content. Yields of purified products varied from 17 to 127 mg./liter of saliva. All human preparations were levorotatory: the subgroup A, ranging from -2.5° to -21°, and subgroup A₂ varying from -27.5 to 37°. Assays of the immunochemical activity and purity showed the phenol-insoluble fraction from saliva to generally have a lower capacity to precipitate hog anti-A than had the 10% precipitates which were 51-54% as effective as hog A substance. The purest preparations, showing maximal activity, were found to be the 10% precipitates from A₂ individuals; these precipitated close to 100% of the glucosamine added as antigen. Immunization of 24 individuals, with several human A preparations from saliva, showed the blood group substance to be antigenic in subjects of blood groups B and O but a poorer antigen than hog A substance.

Kaiser, L., 1928. BEMERKUNGEN UBER DIE WICHTIGKEIT DES SPEICHELs BEIM SPRECHEN (Comments on the importance of saliva in speaking). *Monatschr. f. Ohrenheilk.*, 62 (7-8): 853-856.

The importance of sufficient saliva secretion in proper speech (in particular, in the pronunciation of the labial plosive, "clucking sounds", and the consonant r) is discussed.

Kakhana, M., 1953. K VOPROSU O VLIYANIÍ SLIÛNNYKH ZHELEZ NA UGLEVODNYI OBMEN [Concerning the question of the influence of the salivary glands on carbohydrate metabolism]. *Fiziol. Zhur. SSSR*, 39 (3): 403.

Experimental work by the author in 6 adult dogs has shown that removal of both submaxillary glands is followed, after 7 to 12 days, by a temporary increase in the amount of sugar in the blood. The animals were under observation 3-12 months and no special changes in their general condition was noticed.

A study of the parotid gland was made in 6 other dogs; the parotid glands were removed in 4 of these dogs, the parotid ducts being ligated in the other two. Glycemia was studied before and after the operation, after feeding of 50 g. of glucose, and after injection of 40-60 ml. of a 40% glucose solution. No changes in glycemia were noted in the dogs having ligated ducts; a drop in blood sugar of 14 to 25 mg./100 cc. was noted in two of the 4 dogs having excised glands. No differences were noted in glycemia following administration of glucose.

The author concludes from these findings as well as from a survey of the literature that the removal of the submaxillary glands produces a temporary increase of sugar in the blood, while the removal of the parotid glands produces a certain increase in the insular activity of the pancreas. (These results, as well as those of

other authors in literature, contradict the results of S. M. Dionesov (1952m).

[Kallós, Joseph,] 1939. URIC ACID IN THE SALIVA. The Lancet (London) 236 (6039): 1226.

"Dr. Joseph Kallos has suggested that estimation of the uric acid in the saliva gives a much better idea of the uric-acid production of the body than does examination of the blood or urine. In 100 unselected subjects he found that the saliva uric acid was between 0.9 and 2.4 mg. per 100 cc. in 12 cases; between 2.5 and 4.2 mg. in 61 cases; and between 4.1 and 20.6 mg. in 27 cases. A value of over 4 mg. before food is taken in the morning points to excessive uric-acid formation. Kallos carried out repeated estimations in the same subject and has found that after the intake of foods containing purine bodies the figure may rise 1-7 per cent. He compared the uric-acid values in the saliva and in the urine and found that the former often shows a considerable rise while the latter is normal, and in such cases the clinical manifestations are in harmony with the findings in the saliva. Similarly, a high value for the saliva uric acid was often associated with a normal figure in the blood.

"Kallos method of estimating uric acid in the saliva is simple and takes only a few minutes. Apart from its value in detecting a gouty tendency it may be used for determining the amount of uric acid formed after taking different kinds of food. The saliva uric acid is first estimated with the stomach empty, the food to be tested is then taken, and the saliva is tested again two or three hours later."

Kanaev, I., 1940. SLIŪNŲYĖ REFLEKSY U BLIZNETSOV. K PROBLEME GENETIKI VYSSHEI NERVOI DEIATEL'NOSTI U CHELOVEKA [Salivary reflexes in twins. Contribution to the problem of genetics of the higher nervous function in man]. Priroda, 29 (11): 81-85.

Spontaneous salivation as well as simple conditioned and unconditioned salivary reflexes were studied in 2 pairs of identical twins from the age of 8 to 15 years; tests extending over a year or more were also made in 5 pairs of identical and 3 pairs of fraternal twins. Saliva was collected from the capped parotid duct and registered on a kymograph. Unconditioned salivation elicited by sweetened cranberries showed a greater similarity in average response among identical than among fraternal twins; no correlations were found for the spontaneous salivation which followed the unconditioned secretion. Conditioned salivary reflexes appeared on the same day in identical twins but not in fraternal twins; the conditioned salivary response showed great variation and no genetic relationships were apparent.

Kanter, Frank, and J. L. T. Appleton, 1940. ANTIBACTERIAL EFFECT OF SALIVA ON TUBERCLE BACILLI. Jour. dent. Res., 19 (3): 279-280.

"One part of a suspension of human tubercle bacilli in Ringer's was added to 5 parts of (a) Ringer's, (b) aq. dest., and (c) centrifuged saliva. Samples were immediately inoculated upon Corper's medium....Tubercle bacilli developed from Ringer's and from aq. dest., but not from saliva sample. Saliva, filtered through Jena sintered glass filter G 5/3, and saliva, heated at 56°C. for 30 minutes, likewise inhibit growth of tubercle

bacilli. Above observations hold for salivas of 4 individuals, for none of whom was there history of clinically active tuberculosis. Two reacted strongly, both locally and systemically, to i.c. injection of 0.1 mg. Old Tuberculin. Another was a non-reactor: and chest radiographs of fourth were negative. Centrifuged saliva suspension of tubercle bacilli, injected subcutaneously into guinea-pigs, immediately after mixing (2 animals) and after 2 hours' incubation at 37° (2 animals), produced tuberculosis. Filtered, centrifuged saliva suspensions of tubercle bacilli, injected subcutaneously into guinea-pigs immediately after mixing (3 animals) and after 2 hours' incubation at 37° (5 animals), produced tuberculosis. The inocula were not greater than, and in most cases probably less than, inocula used in in vitro tests. Facts, summarized below, may in part account for rarity of tuberculous lesions of oral mucosa. 1. Centrifuged saliva of some persons without tuberculosis inhibits growth of tubercle bacilli on Corper's medium. 2. This inhibition is not due (a) to bacteria of saliva (although role of filtrable products of bacterial metabolism was not eliminated), (b) to complement-amboceptor mechanism, or (c) to hypotonicity of saliva. 3. This inhibition is manifested with centrifuged saliva, either filtered or unfiltered, which has been diluted with Ringer's solution (1 part saliva, 4 parts Ringer's). 4. Action of saliva, demonstrable in vitro, is not bactericidal, but bacteriostatic and does not render tubercle bacillus avirulent." (Complete paper.)

Kantorowicz, Bruno, and O. Birman, 1953. ACID PRODUCTION IN SALIVA IN RELATION TO AIR CONTACT. Jour. dent. Res., 32 (5): 601-605.

A study of samples of saliva from 61 persons indicated that the production of acids in glucose-saliva mixtures is dependent upon the oxygen tension of the mixture. Acidification is greatly increased at a low oxygen tension.

Karshan, Maxwell, Frances Krasnow, and Laura E. Krejci, 1931. A STUDY OF BLOOD AND SALIVA IN RELATION TO IMMUNITY AND SUSCEPTIBILITY TO DENTAL CARIES. Jour. dent. Res., 11 (5): 634.

"The authors described a study of the hydrogen-ion concentration, alkali reserve, calcium, phosphorus and protein, in blood, hydrogen-ion concentration, titratable alkalinity, calcium and phosphorus in saliva, in individuals either immune from or susceptible to dental caries. Some of the constituents show average values that differ somewhat for the different groups. However, these differences are slight compared with those obtained by other workers and may lack significance in view of the overlapping of so many of the individual figures. The main difference was found in the phosphorus content of saliva, this having been higher in many instances in immune persons than in those susceptible to caries."

Karshan, Maxwell, Frances Krasnow and Laura E. Krejci, 1931a. A STUDY OF BLOOD AND SALIVA IN RELATION TO IMMUNITY AND SUSCEPTIBILITY TO DENTAL CARIES. Jour. dent. Res., 11 (4): 573-589.

Hydrogen ion concentration, titratable alkalinity, calcium and phosphorus contents of resting and stimulated salivas of 44 individuals (17 caries-immune, 6 with arrested caries, and 21

with acute caries) were studied. All saliva samples were collected before breakfast; approximately 80 sets of analyses were made. Colorimetric determinations, in preliminary tests, showed no change in pH when saliva was diluted 1:10 or during the period required for collection. The titratable alkalinity did not change during the collection period of the saliva. A modification of Leonard's method, or a method developed by the authors, was used for calcium determinations. Phosphorus determinations were made by Tisdall's method for inorganic blood phosphate adapted to an HCl solution of ashed saliva; a modification of the above method was used for unashed saliva.

The salivas of two groups of individuals, a caries-immune group and a susceptible one, were analyzed and results compared. In general, higher average pH values were obtained for the immunes than for the susceptibles. Immune values were 7.03 ± 0.15 for resting saliva and 7.54 ± 0.13 for the stimulated saliva. In the susceptibles, values ranged from 6.90 ± 0.12 for resting saliva to 7.39 ± 0.09 for stimulated saliva. The pH of each saliva sample was compared with titratable alkalinity (using methyl orange as indicator). In the stimulated saliva, the average values for titratable alkalinity showed differences similar to those of pH between the susceptibles and immunes; in resting saliva, however, the values for titratable alkalinity were alike in both groups of individuals. Calcium and phosphorus values were higher in immunes than in susceptibles.

Three tables of saliva data and 4 graphs are given.

Karshan, Maxwell, 1936. FACTORS IN HUMAN SALIVA CORRELATED WITH THE PRESENCE AND ACTIVITY OF DENTAL CARIES. Jour. dental Res., 15 (6): 383-393. Abstract: FACTORS IN SALIVA CORRELATED WITH PRESENCE AND ACTIVITY OF DENTAL CARIES. Jour. dent. Res., 15 (5): 366.

A short review of the work of previous authors on salivary composition and its relation to dental caries is followed by the author's own attempts to correlate salivary changes with the presence and activity of dental caries.

Three sets of saliva analyses were performed on 105 individuals once or twice a week. The individuals, ranging in age from 13 to 42, were divided into four groups: caries-free, with arrested caries, with active caries, and miscellaneous, the latter including individuals who had cavities or fillings, but who could not be placed in either the arrested or active-caries groups. Paraffin-stimulated salivas were collected in two portions. Ca, phosphate, and protein determinations were made on the first portion (15 cc.); the second (8 cc.), to which mercuric chloride had been added to prevent changes during standing, was used for ammonia and CO₂ capacity determinations. Total Ca was determined by the method described by Krasnow, Karshan, and Krejci (cf. Krasnow 1932a); phosphate, by Tisdall's method for inorganic phosphate in blood; CO₂ capacity, by the manometric method of Van Slyke and Neill; protein, by the procedure of Greenberg for total serum protein; and ammonia N, by the Permutit absorption procedure of Folin and Bell for urine ammonia N.

Five tables of data are given.

The most significant differences occurred in CO₂ capacity and in percentages of Ca and phosphate removed by shaking saliva with tricalcium phosphate; in these three determinations, the caries-free, the arrested-caries, and the active-caries groups differed markedly from the class as a whole. The difference is clearly associated with the presence and activity of dental caries in that the difference of the active-caries group was opposite in sign to that shown by the caries-free and arrested-caries groups. The salivas of the active-caries group differed from that of the caries-free and the arrested-caries groups since the latter two had significantly higher values for CO₂ capacity and for percentage of Ca removed, and lower values for percentage of phosphate removed by shaking the saliva with tricalcium phosphate. The miscellaneous groups did not differ significantly from the class and yielded mean values nearest to the class mean.

The mean values for total calcium and inorganic phosphate were less in the active-caries group than in the caries-free; similar differences in mean values were found between the active-caries group and the arrested-caries group. In the case of phosphorus and Ca removal, the arrested-caries and the caries-free groups showed differences from the means opposite in sign to those shown by the active-caries group. The author believes that, should larger groups give similar results, significance may be attached to these findings. No significant differences occurred in the values for protein among the four groups.

Karshan, Maxwell, and Theodor Rosebury, 1937. BIOCHEMICAL CHARACTERISTICS OF SALIVA OF KUSKOKWIM ESKIMOS CORRELATED WITH DENTAL CARIES AND SALIVARY CALCULUS. Jour. dent. Res., 16 (4): 307.

The paraffin-stimulated saliva of 49 (17 carious, 28 caries-free, and 4 doubtful) Eskimos was analyzed for total Ca, inorganic P, CO₂ capacity, and change in Ca and P after shaking with tricalcium phosphate; the data were studied in relation to incidence of caries and salivary calculus.

The caries cases gave lower averaged for Ca, P, CO₂ capacity and for the Ca removed after the shaking, while the average P removed after the shaking was greater than in the caries-free group. Differences between the two groups were generally like those previously reported (cf. Rosebury, 1937).

When the data were correlated with salivary calculus, 28 low-calculus cases (including 16 or 17 caries cases) yielded average values similar to the caries group; in 20 moderate or high-calculus cases, the values were similar to caries-free group. An inverse relationship between caries and salivary calculus is suggested.

Results for total Ca and inorganic P are similar to those reported by Tenenbaum, 1937.

No coordination was seen in individual subjects when chemical data were compared with bacteriological findings.

Karshan, Maxwell, 1938. FACTORS IN UNSTIMULATED SALIVA CORRELATED WITH PRESENCE AND ACTIVITY OF DENTAL CARIES. Jour. dent. Res., 17 (4): 328-329.

Chemical analyses were made of the salivas of 59 persons (21 caries-free, 13 with arrested

caries, and 25 with active caries). Two samples were collected from each individual approximately 15 minutes apart, 1 to 3 hours after breakfast. The first sample (15 cc.) was used for Ca, P and protein determinations; the method is discussed in a previous paper (cf. Karshan, 1936m). The second portion (8 cc.) was used for determination of CO₂ capacity. The total calcium varied from 5.7 mg./100 cc. in the active caries cases to 6.5 mg./100 cc. in the caries-free individuals; the inorganic P, from 14.6 to 18.5 mg./100 cc. respectively. Shaking saliva with tricalcium phosphate removed 26% of the Ca for the active-caries cases, 50% for the arrested caries and 54% for the caries-free; the P removed totaled 67%, 60%, and 63% respectively. The CO₂ capacity was 9.5 cc./100 cc. for the active caries, 12.9 for the arrested-caries, and 13.4 for the caries-free individuals. The protein values ranged from 313 mg. per 100 cc. saliva in caries-free individuals to 335 mg./100 cc. in the active caries cases. The percentage protein removed was 55% for the arrested caries, 57% for the caries-free, and 59% for the active caries cases.

Karshan, Maxwell, 1939. FACTORS IN SALIVA CORRELATED WITH DENTAL CARIES. *Jour. dent. Res.*, 18 (4): 395-407.

Stimulated and unstimulated salivas of carious and non-carious individuals were chemically analyzed. Saliva samples were collected in two portions, 15 minutes apart. The first portion (15 cc.) was used for determination of Ca, inorganic P, and protein; the second, for determination of CO₂ capacity. Methods are described in full.

The average values for unstimulated salivas of (a) the caries-free group (21 persons averaging 18.6 years of age), (b) the arrested-caries group (13 persons averaging 21.0 years of age), and (c) the active caries group (25 persons averaging 18.5 years of age), were: Total Ca, 6.5, 6.5, and 5.7 mg./100 cc., respectively; inorganic P, 18.5, 18.5, and 14.6 mg./100 cc.; percent Ca removed, 54, 50, and 26%; percent P removed, 63, 60, and 67%; CO₂ capacity, 13.4, 12.9, and 9.5 cc./100 cc.; and protein removed, 313 (or 57%), 330 (or 55%), and 335 mg./100 cc. (or 59%), respectively.

The average values for stimulated salivas of (a) the caries-free group (11 persons averaging 19.0 years of age), and (b) the carious group (14 persons averaging 18.5 years of age) were: Total Ca, 5.8 and 5.0 mg./100 cc., respectively; inorganic P, 13.5 and 11.6 mg./100 cc.; percent Ca removed, 65 and 27; percent P removed, 24 and 47; CO₂ capacity, 29.3 and 19.4 cc./100 cc.; and protein removed, 239 (or 53%) and 289 mg./100 cc. (or 58%), respectively.

A statistical analysis of all values is presented (Tables V and VII).

Karshan, Maxwell, T. Rosebury, and L. M. Waugh, 1939a. DENTAL CARIES AMONG ESKIMOS OF THE KUSKOWIM AREA OF ALASKA. II. BIOCHEMICAL CHARACTERISTICS OF STIMULATED SALIVA CORRELATED WITH DENTAL CARIES AND OCCURRENCE OF SALIVARY CALCULUS. *Amer. Jour. Dis. Child.*, 57 (5): 1026-1034.

The chemical characteristics of samples of the paraffin-stimulated saliva of 49 Eskimos, aged 6 to 70, were studied. The group included 17 who had active caries, 4 with doubtful caries, and 28 who were free from caries. The total calcium content and the carbon dioxide capacity showed

significant differences between the group with caries and that free of caries.

Differences observed between the 2 groups, after the salivary samples were shaken with tricalcium phosphate, bordered on significance in regard to the amount of calcium removed from the salivas, but were statistically insignificant as to the amount of phosphorus removed. Differences in the inorganic phosphate content of caries-free and caries-active salivas were significant.

Correlation of the chemical data with the presence of dental calculus indicated that the chemical characteristics of the saliva of caries-active individuals resembles that of individuals free from calculus, while that of caries-free persons resembles the group with calculus present.

Karshan, M., P. O. Pedersen, E. H. Siegel, and B. Tenenbaum, 1940. BIOCHEMICAL STUDIES OF THE SALIVA OF GREENLANDERS CORRELATED WITH DENTAL CARIES AND THE OCCURRENCE OF SALIVARY CALCULUS. *Jour. dent. Res.*, 19 (3): 303-304.

"Paraffin-stimulated saliva of natives in 7 settlements in the Julianhaab District, Southwest Greenland, was analyzed for calcium, inorganic phosphate and carbon dioxide combining capacity. The subjects, ranging in age from 14 to 43, were divided into 4 groups-caries-free, arrested-caries, active-caries and miscellaneous. There were 28 caries-free, 9 arrested-caries, 29 active-caries and 21 miscellaneous cases. The mean values for calcium, inorganic phosphate and carbon dioxide combining capacity were greater in the caries-free, arrested-caries and miscellaneous groups than in the active-caries group. The salivary data were regrouped in relation to the occurrence of calculus. The mean values for calcium, inorganic phosphate and carbon dioxide combining capacity were greater in the group with calculus than in the calculus-free group. The data indicate an inverse relationship between the active-caries and calculus groups. The findings for caries and calculus are similar in direction to those previously reported for clinic patients and Alaskan Eskimos." (Author's abstract).

Karshan, M., E. H. Siegel, and L. M. Waugh, 1940a. BIOCHEMICAL STUDIES OF THE SALIVA OF ESKIMOS CORRELATED WITH DENTAL CARIES AND THE OCCURRENCE OF SALIVARY CALCULUS. *Amer. Jour. Dis. Child.* 59 (1): 39-44.

A biochemical study was made of paraffin-stimulated and unstimulated saliva of Kuskokwim Eskimos, aged 7-40. The mean values for calcium, inorganic phosphate, and carbon dioxide capacity were somewhat greater in the caries-free group than in the group with caries. These same mean values were lower in a calculus-free group than in a group with varying amounts of calculus. The carbon dioxide capacity of the saliva seems unrelated to the acid-base balance of the diet.

Karshan, Maxwell, 1942. DO CALCIUM AND PHOSPHORUS IN SALIVA DIFFER SIGNIFICANTLY IN CARIES-FREE AND CARIES-ACTIVE GROUPS? *Jour. dent. Res.*, 21 (1): 83-86.

Analysis is presented of experimental conditions in previous studies (Karshan, 1939m, n.) of the calcium and phosphorus contents of unstimulated saliva collected from caries-free and caries-active groups. Lack of agreement between these findings and those of other investigations is attributed to differences in experimental procedure and in selection of subjects.

Karshan, Maxwell, 1942a. BIOCHEMICAL STUDIES OF DENTAL CARIES. *Amer. Jour. Orthodont. and Oral Surg.*, 28 (8), Oral Surg.: 469-473.

A review is presented of a program of biochemical studies conducted in an investigation of the etiology of dental caries. Findings as to chemical differences in salivas of caries-free and caries groups, as well as coordinated studies in these groups on the blood and on the metabolic balances of elements involved in calcification are discussed and summarized.

Katzenstein, Margarete, 1929. UNTERSUCHUNGEN ÜBER SPEICHEL-LIPASE [Investigations on salivary lipase]. *Zeitschr. f. d. ges. exper. Med.*, 69: 179-192.

"1. In extensive re-examinations of the findings of Scheer and coworkers, it was verified that saliva definitely contains a hydrolyzing enzyme. This lipase, which is not connected with bacterial action, is more abundant in parotid secretion than in mixed saliva; its optimum action lies between pH 7.5 and 7.7, the physiological pH of human saliva.

"2. In recent tests, the lipase content of human saliva in various diseases was studied. A correlation with the clinical picture seems to exist in the following manner:

a) In diseases which are associated with increased salivation, the lipase content is consistently slight. This was shown in several cases of stomatitis, cervical-gland abscesses, Plaut-Vincent's angina, and Feer's disease [erythredema polyneuropathy].

b) In contrast, in diseases associated with a diminution of salivary flow, the lipase concentration is increased, such as in paradentosis, gingivitis, measles, chicken-pox, diabetes mellitus.

c) In scarlet-fever, the hydrolyzing enzyme content was found to be extremely fluctuating, so that a correlation was impossible without further investigation.

"3. In order to prove that the formation of this salivary lipase is not limited to the human organism, similar tests were made on dogs and it was demonstrated that a lipase exists in mixed saliva. Remarkably, it was not found in pure parotid secretion." (Author's summary, translation.)

Kaufmann, 1888. APPLICATION DE LA MÉTHODE GRAPHIQUE À L'ÉTUDE DE LA SÉCRÉTION PAROTIDIENNE CHEZ LE CHEVAL [Application of the graphic method to the study of the parotid secretion in the horse]. *Compt. rend. de la Soc. de Biol. (Paris)*, 40 (38): 815-816.

The use of a manometer to register pressure in Stenson's duct (horse) revealed that secretion of the parotid gland is intermittent, ceasing between meals, active during mastication. Flow is more abundant on the chewing side. A fluctuation in saliva flow accompanies each chewing motion.

Kauffmann, Joseph H., 1923. THE PROPERTIES AND FUNCTIONS OF SALIVA. *Dental Cosmos*, 65 (7): 698-701. Also in *Dental Register*, 77: 357-363. 1923.

A short review of the literature concerning saliva.

Kauffman, Shirley L., G. J. Kasai, and S. A. Koser, 1953. THE AMOUNTS OF FOLIC ACID AND VITAMIN B₆ IN SALIVA. *Jour. dent. Res.*, 32 (6): 840-849.

Microbiologic assays of 51 samples of saliva from 20 persons indicated that the average concentration of folic acid, or substances with folic acid-like activity, was 0.024 micrograms per milliliter of saliva. The values ranged from 0.003 to 0.075 micrograms with 70 percent of the values between 0.008 and 0.039 micrograms per ml.

Assays of 52 saliva samples from 17 persons gave an average concentration of 0.006 micrograms of vitamin B₆, or substances with B₆ activity, per milliliter of saliva. The values ranged from 0.001 to 0.017 micrograms per ml. with 75 percent of the samples giving values between 0.003 and 0.012 micrograms. Pyridoxal hydrochloride was used as the reference standard.

The concentration of both of these substances in saliva is discussed in relation to growth and acid production of oral lactobacilli.

Kazakova, M. E., 1952. MUTSIN SLIÛNY KAK GLIÛCOLIPOPROTEID [Salivary mucin as glycolipoprotein]. *Biokhim.*, Moscow, 17 (2): 195-197.

Saliva from human subjects and from fistulated dogs was filtered and the salivary mucin thus obtained was extracted for 6 hours with boiling ethanol. The sediment was twice washed with diethyl ether after the extraction. Qualitative analysis of the dry residue of the extraction and washings showed the presence of cholesterol. Quantitative analysis of the dry residue showed the cholesterol of the human preparation to vary from 1000 to 1500 mg.%, and the canine preparation from 500 to 620 mg.%. No cholesterol was found in the salivary filtrate, and little cholesterol was revealed by low temperature extraction of mucin with diethyl ether. The results show a stable combination of salivary albumen and cholesterol, so that human and canine salivary mucin is a glycolipoprotein rather than a glycoprotein. The oral defensive function of cholesterol is discussed.

Keating, J. M., 1883. SOME OBSERVATIONS ON THE SALIVARY DIGESTION OF STARCH BY INFANTS. *Boston med. and Surg. Jour.*, 109 (2): 31-32.

Observations were made on the digestive activity of saliva on starch in 21 children ranging from 6 days to 17 months of age, and the determinations tabulated. Findings indicate that the salivary glands of infants, regardless of age, possess the ability to secrete a material that will convert starch into glucose.

Keetom, R. W., and F. C. Koch, 1915. DISTRIBUTION OF GASTRIN IN THE BODY. *Amer. Jour. Physiol.*, 36 (4): 353.

Gastrin, extracted from various tissues of the gastro-intestinal tract, was not obtainable from submaxillary gland tissue.

Kenrick, Frank B., 1931. THE SOUR TASTE OF ACIDS. Trans. Roy. Soc. Canada (Sect. III, Math., Phys., and Chem. Sci.), 25: 227-228.

Preliminary tests indicate a proportionality between acid sourness and the amount of phosphate buffer (pH 7) required to bring an acid solution to pH 5. Rinsing the mouth with bitter substances, or the addition of such substances to acid solutions increases the sourness. The addition of saliva and the exertion of its buffering action upon the acid solution does not appreciably affect the initial sourness or pH.

Kerr, A. C., 1955. CONTINUOUS RECORDING OF THE RATE OF FLOW OF PAROTID SECRETION. Jour. Dental Res., 34 (5): 784.

A description and method of use is given of a polyethylene cannula designed to replace the central chamber of the Lashley cup. Advantages obtained by use of the device are listed.

Kerr, A. C. 1956. THE RELATIONSHIP BETWEEN CHEWING AND THE SECRETORY ACTIVITY OF THE HUMAN PAROTID GLAND. Jour. dent. Res., 35 (6): 963-964.

The reflex response of parotid glands to the chewing of paraffin wax was studied in 6 individuals. Secretion was collected by cannulae retained in the parotid ducts by suction. Secretion rates were measured by an integrating flow meter. When chewing was unilateral the output of the ipsilateral gland was markedly increased. The contralateral gland was only slightly stimulated. Because of this all stimulus response effects were studied unilaterally. Outputs at chewing rates between 40 and 90 strokes each minute were not appreciably different. Below 40 strokes per minute the secretion rate was lower. Above 90 strokes per minute fatigue quickly developed and, although a slightly higher output was recorded for a minute or so, this could not be sustained. The chewing of 2g. pieces of wax of different melting points showed that the secretory response increased with the melting point. Wax melting at 56°C. provoked about 50 percent more secretion than wax melting at 39°C. When pieces of wax varying in size from 0.02 to 2g. were chewed the secretory response was linearly related to the logarithm of the weight of the wax bolus. Chewing on imaginary pieces of wax produced no increase above the basal rates. The secretory response of the parotids to wax chewing thus depends upon the size of the piece of wax chewed, upon its plasticity, and upon the pattern of chewing with regard to the side of the mouth used. The output is not much affected by rates of chewing so long as they are within physiologic limits. (Author's abstract).

Kerr, A. C., and G. A. Rose, 1957. FREE AMINO ACIDS AND PHOSPHOETHANOLAMINE IN THE SALIVARY SECRETIONS OF MAN. Jour. dent. Res., 36 (5): 817.

Samples of parotid gland secretion from 4 normal volunteers, a sample of submandibular gland secretion and a sample of whole saliva also from normal volunteers were ultrafiltered, desalted and examined by 2-way paper chromatography and electrophoresis for ninhydrin reacting substances. The ninhydrin reacting substance present in highest concentration in normal parotid and submandibular secretions was found by

confirmatory experiments to be phosphoethanolamine. Normal whole saliva contained considerably less phosphoethanolamine than the individual secretions. A substance was found in it which was absent from parotid and submandibular secretions. This was probably gamma-amino butyric acid but may have been delta-amino valeric acid. Parotid secretion from 7 patients with metabolic bone disease, 1 with cystinuria and 1 with polycythemia vera were treated the same way. The chromatograms did not differ in any striking way from those of the normals. The cystinuric patient showed no excess of cystine, lysine, arginine or ornithine in his parotid secretion. This suggests that there is no mechanism of specific reabsorption of amino acids from the parotid comparable with the renal tubular reabsorption of amino acids. In 2 patients with osteogenesis imperfecta, the concentration of phosphoethanolamine in the parotid secretion was lower than normal. The hypothesis that the concentration of phosphoethanolamine would inversely reflect the plasma alkaline phosphatase concentration was not supported by observations on the parotid secretions of 4 patients with abnormal plasma alkaline phosphatase concentrations. [Author's abstract].

Kerr, A. C., and D. L. Wedderburn, 1958. THE EFFECT OF THE SECRETIONS OF HUMAN SUBMAXILLARY AND PAROTID GLANDS ON SOME BACTERIA. Jour. dent. Res., 37 (4): 756.

Two types of antibacterial factor have been described in whole saliva (Bibby, 1938p). These factors may have originated in the cells and microorganisms of saliva or may have been secreted by the salivary glands. The present investigation was made to see if submaxillary and parotid secretions had antibacterial activity. Secretions were collected by cannulae from the appropriate gland ducts of 7 volunteers. No epithelial cells or leukocytes were found nor could viable organisms be demonstrated when samples were tested by standard methods. Assays for antibacterial activity were carried out in well-plates against 7 microorganisms. Controls used were lysozyme (10 mg. percent), Ringer's solution, and distilled water drawn through the cannulae prior to collection of secretions. In addition the effect of 6 hours' contact with submaxillary and parotid secretions on *Lactobacillus casei* and *Micrococcus lysodeikticus* was measured by initial and final viable counts. Results obtained by both methods suggest that submaxillary and parotid glands secrete at least 2 types of antibacterial factor. One is a lysozyme-like factor which is not destroyed by heating to 75°C. for 7.5 minutes and the other is a heat labile factor active against 6 lysozyme-insensitive organisms. (Author's abstract)

Kesel, Robert G., Joseph F. O'Donnell, and Ernest R. Kirch, 1945. DEAMINATION OF AMINO ACIDS BY THE HUMAN ORAL FLORA; ITS ROLE IN DENTAL CARIES IMMUNITY. Science (New York), 101 (2618): 230-231, Mar. 2, 1945.

Human saliva inoculated into beef broth medium, incubated for 8 days and then filtered through a Seitz filter, contained a substance which was bactericidal to *Lactobacillus acidophilus*. No acid was formed when a small quantity of the filtrate was added to a saliva which would by itself degrade glucose rapidly. The inhibiting factor

was proved to be ammonia nitrogen. When a solution of an ammonium salt (pH 6.8 or above) was added to saliva in the same concentrations of ammonia nitrogen as produced in salivary cultures, similar inhibiting effects were obtained. Amounts as low as 0.5 mg. of ammonia nitrogen per ml. were sufficient to inhibit L. acidophilus and to prevent fermentation of glucose. Solutions of sodium and potassium salts having the same pH were non-inhibiting.

Earlier studies have shown that the presence of various amino acids was necessary for the production of ammonia in the saliva. Caries-free individuals were observed to have enzyme systems capable of converting at least 6 amino acids into ammonia nitrogen: arginin, alanine, aspartic acid, asparagin, glutamic acid, isoleucine, and serine.

Kesel, Robert G., J. F. O'Donnell, E. R. Kirch, and E. C. Wach, 1946. THE BIOLOGICAL PRODUCTION AND THERAPEUTIC USE OF AMMONIA IN THE ORAL CAVITY IN RELATION TO DENTAL CARIES PREVENTION. Jour. Amer. dent. Assoc., 33 (11): 695-714.

Filtrates of cultured saliva of caries-immune persons incubated for eight days developed an inhibitory agent active against Lactobacillus acidophilus and the conversion of glucose into acid. This agent was found to be ammonia nitrogen. Bacterium lactis aerogenes [Aerobacter aerogenes] was consistently present in caries-immune saliva and seemed to be responsible for much of the ammonia nitrogen production. Increased inhibitory power was noted when A. aerogenes was found in combination with a large gram-positive unidentified bacillus. Amino acids in saliva, as well as urea, were found to contribute to the production of ammonia nitrogen.

The inhibiting factor was not due to alkalinity produced by the ammonia nitrogen since sodium acetate, also producing alkalinity, had no inhibitory power. The incorporation of dibasic ammonium phosphate into a mouth rinse and a dentifrice used by caries-active persons caused a marked reduction in the Lactobacilli counts.

Microbiologic assay of the saliva was conducted in 18 subjects and showed the presence of six amino acids of varying concentrations.

Kesel, Robert G., J. F. O'Donnell, E. R. Kirch, and E. C. Wach, 1947. AMMONIA PRODUCTION IN THE ORAL CAVITY AND THE USE OF AMMONIUM SALTS FOR THE CONTROL OF DENTAL CARIES. Amer. Jour. Orthodont. and Oral Surg., 33 (2), Oral Surg.: 80-101.

Bacteria-free filtrates of saliva (3 ml.), obtained from caries-immune persons and cultured in beef infusion broth at pH 7.6, were added to equal volumes of fresh saliva from a caries-active individual. One ml. of a 2% glucose solution was added to enhance growth of lactobacilli and to permit determination of glucose conversion into acid. Determinations of pH prior to, and after 4, 24, and 48-hour incubation periods showed no change from the initial pH 7.4. Tomato agar subcultures made at 0-hour contact of the filtrate-saliva-glucose solution showed growth of lactobacilli and yeast. Subsequent subcultures after 24, 48, and 72 hours of incubation showed absence of these organisms. Controls, lacking the caries-immune saliva, showed increased growth after 48 hours of incubation. A similar series, in which saliva from caries-active individuals was

substituted for that of caries-immune, showed a pH drop from the initial 7.2 to 4.2 after 48 hours of incubation. In subsequent tests a standard culture of Lactobacillus acidophilus was used to evaluate filtrate inhibitory power, the concentration of culture to filtrate being 1:100.

Studies of the various bacteria present in caries-immune saliva showed the consistent presence of Bacterium lactis aerogenes [Aerobacter aerogenes] and the occasional presence of a large gram-positive, pleomorphic bacillus. Tests of 105 different bacteria showed B. lactis aerogenes, alone to produce an inhibitory filtrate. The gram-positive organism, when cultured with B. lactis aerogenes, increased the inhibitory power of the filtrate; when grown alone it produced no inhibition and degraded no glucose.

Dilution tests of highly inhibitory filtrates showed a 1:1 dilution, with a fresh beef infusion containing 2% glucose, to usually prevent growth of L. acidophilus. A 1:2 dilution eliminated the test organism after a 72-hour contact period. Higher dilutions were ineffective.

Tests of concentrating the filtrate showed loss of potency to occur in direct proportion to the degree of evaporation either by heat or in vacuum at room temperature. Filtrates evaporated to dryness lost all inhibitory power. Tests of the volatile distillate showed the constant presence of ammonia. Subsequent determination of the ammonia nitrogen of all filtrates by the permutit method showed a direct relationship between the amount of ammonia nitrogen present and degree of inhibition exerted by a filtrate. Non-inhibiting filtrates contained little or no ammonia nitrogen; those which did, contained at least 0.5 mg. ammonia nitrogen/ml.

Standard tests of ammonium carbonate in sterile broth medium produced inhibitory results equivalent to those obtained with salivary culture filtrate of similar ammonia nitrogen concentration. Basic ammonium salts were found to be inhibitory, acid salts were not.

Tests of solutions of ammonium acetate and sodium acetate, both at pH 7.2, in broth medium showed abundant growth of lactobacilli in the untreated control, as well as in the tube containing 0.1 ml. ammonium acetate, and tubes containing 0.1, 0.5, and 1.0 mg. of sodium acetate. No growth of lactobacilli occurred in tubes containing either 0.5 or 1.0 mg. of ammonium acetate. It was concluded that the ammonia in the salivary culture filtrate produced the inhibitory effect.

Extended tests of a mouth rinse and a dentifrice containing 5% by weight of dibasic ammonium phosphate in a group of 45 persons having a high (75,000/ml.) lactobacilli count showed a marked decrease in lactobacilli count after a 5 month period. A control group of 10 persons, of similar lactobacilli count and using similar oral preparations lacking the dibasic ammonium phosphate, showed an increase or slight decrease in count during the same period. Further tests extended over a period of a year, using 122 subjects, generally showed an almost immediate reduction of lactobacilli occasionally followed by a sporadic increase. In many cases lactobacilli counts persisted at a level indicating some caries activity.

In vitro tests, using caries-active saliva, showed a combination of 5% dibasic ammonium phosphate and 3% urea to be more effective as a bactericidal and antiacidic agent than either agent

alone, the combination inhibiting all lactic acid production and eliminating all aciduric bacteria after 24 hours incubation at 37°C.

Kesel, Robert G., J. F. O'Donnell, E. R. Kirch, and E. C. Wach, 1947a. THE AMINO ACIDS AND THEIR DEAMINATING SYSTEMS PRESENT IN HUMAN SALIVA. *Amer. Jour. Orthodont. and Oral Surg.*, 33 (2), Oral Surg: 68-79.

Deamination of various amino acids by whole saliva, by Bacterium lactis aerogenes [Aerobacter aerogenes], and by a Gram-positive bacillus was studied in an investigation of the source of the ammonia nitrogen of the mouth. Incubation (48 hr.) of a mixture of 1% solutions of 21 amino acids inoculated with either the aerogenes organism, the bacillus, or a combination of both, produced 3.67 mg. ammonia nitrogen in the tube containing B. aerogenes, 5.16 mg. in the tube containing both organisms, and none in an uninoculated, control tube. Tests of individual acids showed only aspartic acid to be deaminized by B. aerogenes alone or in combination with the bacillus, the combination producing the greater amount of ammonia nitrogen. Addition of glutamic acid to the mixture further increased ammonia nitrogen production, although the bacteria had no effect on glutamic acid alone.

Tests were made of whole, paraffin-stimulated salivas of 28 persons, which were collected in the morning before cleaning the mouth and before breakfast. The saliva from the 14 caries-immune individuals invariably deaminized glutamic acid, alanin, and aspartic acid. Salivas from caries-active persons, containing aciduric bacterial counts of more than 100,000 did not deaminate glutamic acid; variable results were obtained with alanin and aspartic acid as the substrate to the salivas of the caries-active group. Autoclaving of saliva at 15 psi for 15 min. destroyed its bacterial and enzyme content and prevented subsequent deamination. Addition of small amounts of nutrient medium to salivary samples increased gas production 7- to 8-fold. Microbiologic assay of salivas of 18 individuals showed the presence of tryptophan, glutamic acid, isoleucine, serine, valine, arginine, threonine, lysine, glycine, tyrosine, and phenylalanine. Values tabulated for these acids show variations in the amino acid content irrespective of caries activity.

Kesel, Robert G., E. R. Kirch, J. F. O'Donnell, and E. C. Wach, 1949. RECENT DEVELOPMENTS IN THE BIOLOGIC PRODUCTION OF AMMONIA AND THE USE OF AMMONIA AND CARBAMIDE IN CARIES PREVENTION. *Oral Surg.*, 2 (4): 459-473.

A study of ammonia production in the oral cavity showed that invariably more ammonia was found than could be accounted for by the conversion of all of the urea in saliva. This salivary ammonia is augmented by that produced by 17 amino acids which have been found to be present in saliva in varying amounts. Sugar was found to have a depressing effect on the natural ammonia-producing mechanism and a stimulating effect on acid formation. Five percent dibasic ammonium phosphate and three percent carbamide had a synergistic effect in destroying lactobacilli and preventing lactic acid formation from glucose degradation.

Kesel, Robert G., 1950. AMMONIUM IONS VS. ORAL LACTOBACILLI. *Jour. dent. Res.*, 29 (6): 843-844.

Attention is called to several discrepancies in the work of Kirchheimer and Douglas (Kirchheimer, 1950m) which failed to confirm the author's findings on inhibition of oral lactobacilli by ammonium ions (Kesel, 1947m, n). The inability of ammonia to inhibit various strains of oral lactobacilli under certain conditions is not demonstrated.

Keztyus, L., and J. Martin, 1937. ÜBER DEN EINFLUSS VON CHORDA- UND SYMPATHICUSREIZUNG AUF DIE ZUSAMMENSETZUNG DES SUBMAXILLARSPEICHEL [On the effect of the stimulation of the chorda and of the sympathetic on the composition of the submaxillary saliva]. *Pflüger's Arch. ges. Physiol.*, 239 (4): 408-418.

The submaxillary glands of dogs were fistulated and the chorda was stimulated by induction current on one side, stimulation was maintained until 34-40 cc. saliva was obtained. Then the cervical sympathetic was stimulated on the opposite side, with a different induction current. Having obtained about 5-10 cc. sympathetic saliva, the gland was similarly stimulated through the chorda tympani.

Sympathetic submaxillary saliva was higher in K, Ca, and organic matter, and lower in Na, and Cl than similar chorda saliva. The higher amount of dry residue in the sympathetic saliva was due to the higher mucin and albumin values. Following stimulation of both the sympathetic and the parasympathetic the percentual concentration of K, Na, Cl, and organic dry residue decreased parallel to the amount of the saliva secreted. The percentual concentration of Ca decreased only in the sympathetic saliva; in the chorda saliva it stayed practically at the same level. Sympathetic stimulation had no effect on the inorganic dry substances of the chorda saliva, but an increase was seen in organic dry substances.

Keztyus, L., and J. Martin, 1938. ÜBER DIE HERKUNFT UND AUSSCHIEDUNG DES CALCIUMS IN CHORDA-SPEICHEL. [The origin and secretion of calcium in the chorda saliva]. *Pflüger's Arch. ges. Physiol.*, 241 (2-3): 241-247.

The submaxillary gland of the dog was fistulated and Ca determinations were made both in the blood and the saliva according to Kramer's and Tisdall's method. Following stimulation of the chorda tympani for a period of 10 - 15 minutes, 20 cc. of saliva was obtained.

Results indicated that chorda saliva contained Ca in the same concentration as the blood. The salivary Ca content was between the arterial and venous Ca values. These concentrations depended neither on the amount of saliva secreted, nor on intensity of stimulation of the chorda, but fluctuate according to the Ca content of the blood. Thus it is surmised that the secretion of the salivary Ca does not originate as a glandular secretion but as a filtering process. Calcium apparently has a greater retention ability than other organic and inorganic dry residues contained in the saliva.

Khvoles, G. IA., B. A. Minin, and E. I. Turbina, 1945. SOSTOIANIE SEKRETORNOI I MOTORNOI FUNKTSII PISHCHEVARITEL'NOGO TRAKTA PRI NEPOSREDSVENNOM DEISTVII KALIĖA I KALTSIIĖA NA NERVNYE TSENTRY. [The condition of the secretory and motor function of the digestive tract during direct action of potassium and calcium on the nervous centers]. Biull. eksper. Biol. Med., Moskva, 19 (4-5): 44-48.

Study was made of changes in digestive functions after injection of 0.25 to 0.5 cc. of 1/6 M potassium phosphate at pH 7.4, or of 0.25 cc. of isotonic calcium gluconate, into the cerebral ventricle. The effects of such injection on food-, acid-, or pilocarpine-stimulated salivation was investigated in dogs with fistulated submaxillary-sublingual salivary glands. Suboccipital injection of potassium phosphate produced great excitement and refusal of food; a considerable decrease in both salivary flow and chloride-content of secretion stimulated by acid or pilocarpine was noted during the 30-minute duration of the potassium effect. Injection of the calcium gluconate produced general depression, spontaneous salivation, and an increase in both flow and chloride-content of saliva elicited by food or acid; pilocarpine had no salivary effects. The potassium is considered to act on the sympathetic centers to inhibit salivation and depress its chloride content, while calcium stimulates the parasympathetic centers to produce a chordal-type of saliva, rich in chlorides.

Kibiakov, A. V., and D. S. Malkina, 1949. O VLIĖANII NAPOCHECHNIKOV NA SIMPATICHESKIJ INNĖRVIATSIJ SLIUNNYKH ZHELEZ. [Concerning the influence of the adrenal glands on the sympathetic innervation of the salivary glands]. Fiziol. Zhur. SSSR., 35 (6): 687-692.

Samples of submaxillary chorda and sympathetic saliva were collected from dogs under chloroform-ether narcosis 2 to 8 days after removal of one adrenal gland and decortication of the other. Samples of both types of saliva were weighed after desiccation and again after calcination, the difference between the two weights being used to indicate the organic content of the saliva.

Tests of salivary samples from non-operated control dogs showed sympathetic saliva to contain 1 to 2.1% more organic matter and 0.1 to 0.3% more inorganic matter than chorda saliva. Similar tests of salivary samples from operated dogs showed, beginning with the fifth day after operation, a decrease in the solid residue of sympathetic saliva, the drop occurring principally in the salivary organic matter.

In a third series of experiments, samples of sympathetic and chorda saliva were collected from dogs 4 to 8 days after removal of one adrenal gland and inactivation of the adrenal cortex of the other gland by thermal cauterization. Analysis of salivary samples showed a sharp reduction in the solid (principally organic) content of the sympathetic saliva to occur 5 days after the operation. The solid content of the sympathetic saliva approached, or became less in some cases, than that of chorda saliva. The inorganic content showed only insignificant variation. No reduction in the organic content of the chorda saliva was noted.

In a fourth series of experiments 0.5 cc. of a 1:1000 solution of adrenalin was administered to the operated dogs daily or every other day.

Examination of the saliva obtained under these conditions showed sympathetic saliva to increase sharply in organic content, approximately to the pre-operational level. Insignificant variation was noted in the inorganic content of the saliva.

Kim, M. S., and A. C. Ivy, 1936. THE GASTRIC SECRETAGOGIC VALUE OF VARIOUS DIGESTIVE SECRETIONS. Amer. Jour. Physiol., 115 (2): 386-388.

In this experiment, the purpose was to ascertain if saliva, bile, or pancreatic juice might stimulate gastric secretion when in contact with the gastric mucosa. It was also to be determined whether or not there was exerted a local secretagogue action by any of these agents. Three dogs were prepared with a pouch of the entire stomach and a duodeno-esophageal anastomosis. The continuous secretion of the stomach was collected for several 1/2 hour periods, and then the pouch was perfused with 50 cc. quantities of the digestive secretions for 1/2 hour each. The saliva which was not diluted, had no apparent effect on the secretory rate, which remained constant; the secretagogic effect was slight compared to that produced by meat juice or liver.

King, W. J., R. D. Manahan, and K. L. Russell, 1955. METHODS FOR SCREENING POSSIBLE INHIBITORS OF DENTAL CARRIES. Jour. Dental Res., 34 (5): 703.

Precipitated salivary mucin and commercial casein were found useful as protein substrates to determine the retention qualities of various possible oral acid inhibitors. Acid formation was found to be inhibited in some cases when these treated proteins were introduced into an appropriate nutrient with acidogenic salivary organisms. Screening results of such protein retention tests are presented for several dozen compounds not rejected because of other factors such as toxicity and instability. Among the most effective of these are: penicillin, Aureomycin hydrochloride, Chloromycetin, sodium-N lauroyl sarcosinate, Terramycin hydrochloride, and 5-nitro-2-furoic acid. (From author's abstract)

Kirch, Ernst, R., Robert G. Kesel, Joseph F. O'Donnell, and Edward C. Wach, 1947. AMINO ACIDS IN HUMAN SALIVA. Jour. dental Res., 26 (4): 297-301.

The presence of amino acids was determined in salivary samples collected from 18 persons who had been classified into three groups according to their caries activity and to *Lactobacillus acidophilus* counts as caries-inactive (6), moderately active (7), and very active (5).

The samples were collected two hours after the morning meal, were autoclaved, and were stored for not more than 24 hours prior to examination. The pH was adjusted to 6.8, and dilutions were made with distilled water. To facilitate the determination of total amino acids in the saliva, a standard series of cultures was prepared with known amino acid content. A particular strain of a test organism (*Lactobacillus casei*, *L. arabinosus*, *L. delbrückii*, etc.) was inoculated into a special medium in a series of tubes. The tubes contained increasing amounts of amino acids as the sole limiting growth factor. After 72 hours incubation, the acid produced was determined by titration with sodium hydroxide. A curve was constructed by plotting the number of ml. of alkali against each level of amino acid tested. The

amino acid content of the saliva sample could thus be determined from the standard curve. Duplicate tubes were run at each level of the unknown and of the amino acid standard.

At least 16 amino acids were found in the saliva (methods of assay are given). There was no relationship between concentrations of the acids present and caries activity. In two cases, one caries-active and one caries-inactive, the variation of glutamic acid and tryptophane content over a 24-hour period was determined. For the caries-inactive individual, the glutamic acid content ranged from 4 to 8.2 mg/100 cc. and the tryptophane values ranged from 0.175 to 0.235 mg/100 cc. For the caries-active person, the glutamic acid content ranged from 11.5 to 23 mg/100 cc. and the tryptophane values, from 0.5 to 1.35 mg/100 cc.

When saliva samples from various persons were collected during a definite time period in an effort to calculate the amino acid secretion on a time basis, no correlation between caries activity and amino acid production was established.

Kirch, E. R., R. G. Kesel, J. F. O'Donnell, and E. C. Wach, 1950. AMINO ACIDS IN SALIVA OF HUMAN BEINGS ON A LOW PROTEIN DIET. *Jour. dental Res.*, 29 (6): 779-783.

The amino acid contents of the salivas of seven women were studied over a two-year period. No correlation could be established between the salivary amino acids and caries activity, nor between amino acid content and low nitrogen dietary intake. The presence of salivary amino acids in measurable amounts in persons on low nitrogen diets is stressed.

Kirch, E. R., R. G. Kesel, J. F. O'Donnell, and E. C. Wach, 1953. INFLUENCE OF INGESTION OF SINGLE AMINO ACIDS ON THE LEVEL OF FREE AMINO ACIDS IN HUMAN SALIVA. *Jour. dent. Res.*, 32 (1): 57-60.

A study was made of the effect of the ingestion of 5 gm. of one amino acid on the concentration of that amino acid in the saliva. The following free amino acids were determined microbiologically: isoleucine, tryptophane, valine, threonine, cystine, lysine, arginine, leucine, histidine, tyrosine, phenylalanine, and methionine. The saliva levels of all the free amino acids were found to rise significantly following ingestion of the corresponding amino acid. The concentrations were back to normal levels within 30 to 60 minutes.

Kirk, Edward C., 1887. A CONTRIBUTION TO THE ETIOLOGY OF EROSION. *Dental Cosmos*, 29 (1): 50-58.

A presentation is made of the various theories of the etiology of erosion of the teeth and the clinical aspects of the condition are described. The role of the acidity and alkalinity of buccal and salivary secretions on erosion is discussed.

Kirk, Edward C., 1903. THE SALIVA AS AN INDEX OF FAULTY METABOLISM. *Dental Rev.*, 17 (5): 383-395.

Experiments are cited and described which pertain to the observation of conditions of faulty metabolism by the detection of various amounts of end products or incompletely metabolized substances in saliva.

Kirk, Edward C., 1909. THE ETIOLOGY OF DENTAL CARIES. *Dental Cosmos*, 51 (12): 1448-1451.

The alkaline reaction of saliva is considered to hold salivary mucin in solution. Addition of a small amount of lactic acid causes the mucin to precipitate. This mechanism is thought to surround, agglutinate, and fix the lactic acid-producing bacteria in a mucoid film or plaque to the tooth surface.

Kirk, Edward C., 1910. A CONSIDERATION OF THE QUESTION OF SUSCEPTIBILITY AND IMMUNITY TO DENTAL CARIES. *Dental Cosmos*, 52 (7): 729-737.

Addition of a drop or two of lactic acid in almost any concentration to a few cc. of saliva causes precipitation of the mucin as a coagulum or film which spreads out through the liquid and increases in consistency as it falls to the bottom. Experimental production of the mucoid film or plaque was accomplished in vitro by inoculating a glucose-mucin pabulum with microorganisms from dental caries. The medium was made alkaline by addition of dibasic sodium phosphate. Precipitation of the mucus as a large plaque followed fermentation and increase in pH which was demonstrated by a color change in the litmus indicator of the medium.

Kirk, Edward C., 1914. A RECONSIDERATION OF THE ETIOLOGY OF DENTAL CARIES, AND A NEW THEORY OF CARIES SUSCEPTIBILITY. *Dental Cosmos*, 56 (1): 1-11.

A review of the literature and a discussion of the etiology of dental caries is presented. Susceptibility to caries is thought to be due to the metabolic carbohydrate in the saliva being split into lactic acid, and not just to carbohydrate debris left about teeth.

Kirk, Edward C., 1915. THE CHEMISTRY AND PHYSIOLOGY OF THE SALIVA. *Dental Cosmos*, 57 (1): 33-43.

A report is presented of the contributions of American scientists since 1909 to the study of the chemistry and physiology of saliva. These studies include work on the presence and activity of thiocyanate in the saliva, the effect of salivary mucinates on bacterial plaque, tartar, and calculus formation, measurement of pH and other physical and chemical characteristics of saliva, presence and effect of dissolved carbohydrate in saliva, as well as the effects of various foods and body conditions on the varying composition of saliva.

Kitchin, Paul C., and Dorothy Permar, 1948. RESULTS OF A THREE-YEAR STUDY OF THE EFFECTIVENESS OF CARBOHYDRATE RESTRICTION IN REDUCING SALIVARY LACTOBACILLUS COUNTS. *Jour. dental Res.*, 27 (3): 316-319.

"Of [saliva] specimens from 559 individuals examined for active dental caries as indicated by counts of oral lactobacilli, 137 individuals were found to be caries inactive, and 422 caries active. Of the caries-active, 216 successfully completed Plan I [*] of the dietary treatment.

*The experiment employed four different dietary plans: Plan I consisted of two weeks feeding on a limited amount of carbohydrates in the form of bread, potatoes, and an increased variety of vegetables and fruits. This plan is gradually supplemented with fruits and vegetables and limited amounts of sugar (Plans II and III) up to Plan IV, when the patient returns to a nearly unrestricted diet, but with low sugar consumption.

Of these, 138 have so far completed the course of treatment ninety-five of these finishing with low lactobacillus counts. Twenty-four of the ninety-five had been examined six months later, and twenty-one had retained low counts. Eight of these twenty-one had been examined after one year following treatment, and seven of these had retained low counts. One individual was examined after two years following dietary treatment and the count was low. These results compare favorably with those recently presented by Jay [cf. Jay, 1947m]. (Authors' summary.)

Kitchin, Paul C., Hamilton B. G. Robinson, Dorothy Permar, and Andrew H. Imhoff, 1950. OBSERVATIONS OF SALIVARY LACTOBACILLUS COUNTS FOR A PERIOD BEFORE AND AFTER TOPICAL APPLICATIONS OF TWO PER CENT SODIUM FLUORIDE. Jour. dental Res., 29 (5): 679.

"A total of 77 children, aged 7 to 9 and 14 to 16 years, were divided into experimental and control groups. The experimental groups received 4 topical applications of 2 per cent sodium fluoride, the first preceded by an oral prophylaxis. The control received only an oral prophylaxis. Salivary lactobacillus counts were taken before and at intervals after the treatments for 1 year for the 14- to 16-year age group, and for 2 years for the 7- to 9-year age group. The counts showed no consistent differences; no changes were observed in the salivary lactobacillus counts of the experimental group that were not of an order equal to those of the control groups." (Complete paper.)

Kitchin, Paul C., H. B. G. Robinson, D. Permar, and A. H. Imhoff, 1951. OBSERVATIONS ON SALIVARY LACTOBACILLUS COUNTS FOR A PERIOD BEFORE AND AFTER TOPICAL APPLICATIONS OF TWO PERCENT SODIUM FLUORIDE. Jour. dent. Res., 30 (2): 251-259. [Advance abstract: Jour. dent. Res., 29 (5): 679, 1950.]

A study was made of the salivary lactobacillus counts of children before and after the topical application of 2 percent sodium fluoride. Two groups of children were used: Group A consisted of 28 children, aged 7 to 9 years, who were treated for 22 months; Group B consisted of 49 children, aged 14 to 16 years, who were treated for 11 months. Each group was further divided into an experimental and control subgroup. Each member of the control group received an oral prophylaxis, while the experimental group received an oral prophylaxis followed by 4 topical applications of 2 percent sodium fluoride. No consistent reduction was noted in the salivary lactobacillus counts of the experimental groups and no changes in the count were noted that were not equally true of the control groups.

Kitchin, Paul C., and D. Permar, 1955. RESULTS OF AN EIGHT-YEAR STUDY OF THE EFFECTIVENESS OF CARBOHYDRATE RESTRICTION IN REDUCING SALIVARY LACTOBACILLUS COUNTS. Jour. Dental Res., 34 (1): 89-93.

A report is presented concerning the reduction in numbers of salivary lactobacillus produced by restriction of carbohydrates in the diet. Of the 1089 subjects studied, the initial salivary lactobacillus counts showed 811 to have over 10,000 lactobacilli/cc. of saliva, and 278 to have less than 5000/cc.; 101 of the latter subsequently had

higher counts. Records of the caries-active group show 410 subjects to have low counts after 2 weeks on diet Plan I; 318 of this group completed plan II with low counts; 225 of the 318 completed plan III with low counts, and 142 continued on plan IV showing low counts after 2 weeks on the diet.

A 6-month check showed 11 of 126 subjects still on plan IV to have low counts. Low counts were found in 53 of 75 such subjects on Plan IV after 1 year, 25 of 34 such subjects after 2 years, and 14 of 23 such subjects after 3 or more years on the low sugar diet.

Kite, Owen W., James H. Shaw, and Reidar F. Sognnaes, 1950. THE PREVENTION OF EXPERIMENTAL TOOTH DECAY BY TUBE-FEEDING. Jour. Nutrition, 42 (1): 89-103.

Desalivated and intact albino rats were used to study the effects of tube-feeding on tooth decay. Both gross dental samples and histological techniques demonstrated a significant absence of dental caries in both the intact and desalivated animals. The enamel of the teeth of tube-fed rats also showed a lack of stain-ability and a greater mineralization of the organic frame-work of the tooth enamel than did the controls.

An abundance of microorganisms was found in the molar teeth of both the tube-fed and control animals. However, the organisms in the tube-fed were in less intimate contact with the impacted foreign matter in the molar fissures, or separated from the enamel surfaces by a heavy membrane (possibly Nasmyth's membrane).

Klapper, C. E., 1951. INFLUENCE OF SALIVARY GLAND EXTIRPATION ON DEVELOPMENT OF DENTAL CARIES IN THE SYRIAN HAMSTER. Jour. Dental Res., 30 (4): 486.

"In these laboratories it has been observed that hamsters, maintained on a noncariogenic laboratory diet until 45 days of age, resist the development of dental caries when placed on a modified H. W. C. diet (sucrose completely replacing coarse corn). When caries does occur, it is confined primarily to the third molars. In this study, 30 adult Syrian hamsters, 45 to 70 days of age, had the major salivary glands removed. Prior to the operation they were fed a noncariogenic laboratory diet. For a period of approximately 100 days after the operation they were maintained on the modified H. W. C. diet. On this regime, severe caries developed in almost all of the molar teeth. The greatest destruction has been observed in the first molars and the least in the third molars. The severity and pattern of the experimental caries is in sharp contrast to that observed in nondesalivated animals and points to the important protective role of saliva in the production of dental caries in the adult Syrian hamster." (Author's abstract)

Klapper, C. E., 1953. DENTAL CARIES IN DESALIVATED HAMSTERS MAINTAINED ON A STARCH DIET. Jour. Dental Res., 32 (5): 659-660.

"Preliminary studies on the influence of salivary glands on the development of experimental dental caries have been reported from these laboratories. It has been established that little or no dental caries will result in animals placed on a cariogenic diet after they have reached an age of 35 days. In contrast, partially desalivated adult animals show definite tooth lesions

when placed on a high-sugar cariogenic diet. Only minimal caries are found when partially desalivated adult animals are placed on a cariogenic diet in which starch replaces the sugar. Partially desalivated animals are those in which either the submaxillary and sublingual glands have been removed or the parotid duct has been ligated and severed. The investigation has been expanded by completely desalivating a group of twenty-four Syrian hamsters. At approximately 40 days of age they were placed on a modified Hopper, Webber, Caniff diet made up of 60 per cent cornstarch, 36 per cent whole milk, 3 per cent alfalfa meal, and 1 per cent chloride. All animals were sacrificed 115 days later. Fairly extensive caries were found in the teeth of all of these animals. An average of nine carious teeth were present. The average total number of caries was fourteen per animal. These results establish the fact that definite and extensive carious lesions develop in the molars of hamsters in which the only source of saliva is from the small intramural glands of the oral cavity and maintained on a diet with a high concentration of starch. It has been established previously that the type of saliva is not important in the development of experimental dental caries. In animals maintained on the same diet in which only the parotid glands were left intact, the caries score and pattern was similar to that of animals in which the submaxillary and sublingual glands were the only normally functioning major salivary glands. The findings of the present experiment lend added support to the hypothesis that the mechanical cleansing action of the saliva is of paramount importance in the elimination of production of experimental dental caries by a starch diet." (Author's abstract)

Klapper, C. E., and J. F. Volker, 1953a. THE EFFECT OF PARTIAL IMPAIRMENT OF SALIVARY GLAND FUNCTION ON DENTAL CARIES IN THE SYRIAN HAMSTER. *Jour. dent. Res.*, 32 (2): 227-231.

The removal of both the submaxillary or sublingual salivary glands or ligation of the parotid ducts resulted in a high caries score in hamsters fed a high sucrose diet. A similar procedure resulted in a low caries score in hamsters fed a high starch diet. It is suggested that the volume of salivary flow remains sufficient to remove starch from the oral cavity before it undergoes appreciable amylatic hydrolysis as long as a major salivary gland or group of glands is functioning.

Klapper, C. E., and J. F. Volker, 1953b. THE INFLUENCE OF IMPAIRED SALIVARY FUNCTION ON DENTAL CARIES IN THE SYRIAN HAMSTER. *Jour. dent. Res.*, 32 (2): 219-223.

The salivary glands of 25 Syrian hamsters, 45 to 70 days of age, were removed or made non-functional in order to determine the effect of the absence of salivary secretion on the caries rate of animals kept on a sucrose, cornstarch, or laboratory diet. The group on a sucrose diet had an average caries score of 39.4, those on a cornstarch diet had a score of 23.4, and those on the laboratory diet had an average score of 14.6. It is suggested that oral bacterial amylases or certain minor salivary glands may accomplish the

hydrolysis of polysaccharides even though the salivary amylase is missing.

Klapper, C. E., and J. F. Volker, 1955. THE EFFECT OF POWDERED WHOLE MILK-SORBITOL DIETS ON DENTAL CARIES IN DESALIVATED HAMSTERS. *Jour. Dental Res.*, 34 (5): 703

An investigation of the cariogenic effects in hamsters, of various experimental diets in the absence of saliva, showed sorbitol to have little or no apparent cariogenic potential.

Klauder, Joseph V., and J. A. Kolmer, 1921. WASSERMAN TEST WITH SECRETIONS, TRANSUDATES, AND EXUDATES IN SYPHILIS. *Jour. Amer. med. Assoc.*, 76 (24): 1635-1639.

The Wasserman test was conducted with the saliva of twenty patients with syphilis. The majority of the cases were untreated, in the secondary stage of the disease, and some had mucous patches in the buccal cavity. The blood Wasserman's were all ++++ but the saliva was extremely uncomplementary and the reactions were all negative excepting one which gave a weakly positive reaction. It is noted that this patient had a profuse eruption on the buccal mucosa. Fluid taken directly from the mucous patch was also positive.

Kleinberg, I., 1958. THE EFFECT OF DIFFERENT CONCENTRATIONS OF GLUCOSE ON THE pH OF DENTAL PLAQUES IN VIVO. *Jour. dent. Res.*, 37 (4): 756.

Preliminary invitro studies of saliva-glucose mixtures agree in general with in vivo study of the effect of glucose concentrations, maintained constant at different levels, on plaque pH's of selected interproximal areas. The steady state pH was found to be a function of glucose concentration; at low concentrations the pH drop is submaximal, reaching a maximum at 5%, and then showing some inhibition at 50%. Results of tests permitting the glucose concentration to fall from various initial values are also reported. (From author's abstract)

Kleitman, Nathaniel, 1927p. THE EFFECT OF STARVATION ON THE DAILY CONSUMPTION OF WATER BY THE DOG. *Amer. Jour. Physiol.*, 81 (2): 336-340.

Measurement was made of the quantities of water consumed by 6 dogs during periods of normal feeding and of starvation, and also while receiving injections of pilocarpine. The usual amount of saliva secreted as a result of subcutaneous injection of pilocarpine (0.5 mg./kilo) varied from 100 to 200 cc. The water intake usually increased, possibly as a result of water loss through secretion of the saliva.

Kleitman Nathaniel, and George Crisler, 1927a. A QUANTITATIVE STUDY OF A SALIVARY CONDITIONED REFLEX. *Amer. Jour. Physiol.*, 79 (3): 571-614.

Daily subcutaneous injections of morphine sulfate administered to 8 dogs produced conditioned nausea accompanied by salivation. The secretion of saliva is first stimulated, then depressed by the injection of morphine. Salivation usually stops in 15 to 20 minutes. The rate of saliva secretion before the injection gradually increases during development of the reflex and remains practically constant when the reflex is

fully developed. The greater the rate of the conditioned salivation the sooner will the depression produced by morphine set in. The total quantity of saliva secreted in one hour by a 12 to 14 kilo dog may amount to 300 to 400 cc.

Kleitman, Nathaniel, 1927b. THE INFLUENCE OF STARVATION ON THE RATE OF SECRETION OF SALIVA ELICITED BY PILOCARPINE, AND ITS BEARING ON CONDITIONED SALIVATION. *Amer. Jour. Physiol.*, 82 (3): 686-692.

The salivary secretion rate upon pilocarpine stimulation was studied in dogs during alimentary, starvation, and realimentation. Three dogs received subcutaneous doses of 0.5 mg. of pilocarpine sulfate per kilogram of body weight every other day. Animals had permanent fistulae of one of the submaxillary glands and saliva was collected in tubes, attached to their lower jaws, in successive 5-minute periods, usually up to one hour, while the animal remained standing.

Repeated administration of pilocarpine failed to elicit a salivary conditioned reflex, such as had been reported earlier (Kleitman et al., 1927). All the dogs showed a marked decrease in the total volume of saliva secreted during starvation, this decrease amounting to 20-33% of the normal. There was an immediate partial recovery of secretory activity upon realimentation; recovery was not complete after 40 days of realimentation.

It is concluded that during starvation the physiological condition of the central nervous system itself is changed to such an extent that conditioned reflexes (salivary reflex) cannot be developed fully or, if already developed, cannot be maintained in spite of continued application of the unconditioned with the conditioned stimuli.

Kleitman, Nathaniel, 1927c. WHAT CAUSES THE PSYCHIC SECRETION OF SALIVA IN THE DOG? *Proc. Soc. exper. Biol. Med.*, 24 (6): 585-586.

Dogs with submaxillary fistulae, starved for several days, were exposed to the sight of food enclosed in a glass jar 2 to 3 inches from their snouts. No saliva was secreted within a 1/2 hr. exposure. When the cover was removed from the food, saliva was secreted at the rate of 0.5 to 2.5 cc./15 min. It is, therefore, concluded that the psychic flow of saliva is solely due to the odor of the food, and not the sight of it.

Kleitman, Nathaniel, 1930. THE EFFECT OF CONTINUED STIMULATION AND OF SLEEP UPON CONDITIONED SALIVATION. *Amer. Jour. Physiol.*, 94 (1): 215-219.

Among the dogs used in the morphine-conditioned salivation study was a female which responded in a striking manner to demonstrate the effect of continued stimulation and sleep upon conditioned salivation. All of the test animals had demonstrated, after they had been placed in the test stand for a few days, a conditioned salivation which resulted from being in the stand before the morphine was injected. The female mentioned salivated 10-25 minutes after the injection of the morphine, as did the other animals. However, she seemed to be less depressed by the morphine, and the conditioning effect of the stand became more and more pronounced, reinforcing the post-morphine secretion. When the full development of this joint conditioning occurred, salivation continued

as long as the dog was left in the stand. On one occasion, 169.6 cc. of saliva was secreted in 4 hours and 35 minutes; another time, 194.1 cc. was secreted in 5 hours and 40 minutes. This dog also had a tendency to fall asleep while in the stand, both before and after the morphine injection. The salivation gradually decreased as the animal became more drowsy, and ceased when the dog fell asleep. A flare-up of the salivary flow occurred when the dog awoke.

Kleitman, Nathaniel, 1930a. EFFECT OF HISTAMINE UPON THE SALIVARY FLOW INDUCED BY PILOCARPINE IN DOGS. *Proc. Soc. exper. Biol. Med.*, 28 (2): 134-135.

The effects of subcutaneous injections of histamine on salivary secretion was observed in 3 unanesthetized dogs with permanent fistula of one of the submaxillary glands. An injection of histamine sulphate (1-5 g.) failed to produce any secretion; moreover, when 1 mg. of histamine was administered 20 minutes previous to a subcutaneous injection of pilocarpine (1/3 mg. pilocarpine sulphate 1 kg.), it inhibited the stimulatory action of the pilocarpine. In one dog, salivary secretion elicited by pilocarpine alone ranged from 39.7 to 54.9 cc./hr. (average, 47.6 cc.); when a preliminary injection of histamine was given, the flow ranged from 26.6 to 37.6 cc. 1 hr. (average, 32.5 cc.). In all tests, the largest amount of saliva collected in 5 minutes under pilocarpine alone was 12.8 cc; when histamine was administered previous to the pilocarpine, the largest amount was 8.6 cc.

Kliorin, A. I., 1947. O KOLICHESTVENNYKH SOOTNOSHENIIAKH SLIUNOOTDELENIYA NA VODU, KISLOTU I PILOCARPIN U CHELOVEKA [On the qualitative correlations of salivary secretion in man in response to water, acid, and pilocarpine.] *Biull. eksper. Biol. Med.*, Moskava, 24 (1): 200-202.

Parotid salivary response to a 3-minute oral rinse and then ingestion of 30 cc. of either water or of citric acid solutions (0.125, 0.25, 0.5, 0.75, 1.0 or 1.25%) as well as to subcutaneous injection of 1% pilocarpine was studied in 20 adult subjects. Twelve of the subjects had organic or functional nervous diseases not disturbing salivation. Saliva was collected from the capped parotid duct during the rinse and for 3 minutes after ingestion. Results of 10 to 20 tests per subject in addition to 60 tests of the author showed an increased salivary response proportional to increase in acid concentration up to a generally optimal 0.75%; individual variation in response was noted. Response to the 1.0% acid solution was approximately 10-fold that to water. An increased response to pilocarpine injection was found in subjects showing increased response to water and acid. Changes in room temperature had no effect on test results.

Kneen, Eric, and R. M. Sandstedt, 1946. DISTRIBUTION AND GENERAL PROPERTIES OF AN AMYLASE INHIBITOR IN CEREALS. *Arch. Biochem.*, 9 (2): 235-249.

Investigations showed the presence of a substance in wheat endosperm which inhibits the salivary amylase (similar to the amylase inhibitor present in Leoti and Schrock sorghums and in rye). The substance has the following properties: 1)

It is soluble in water, dilute saline solutions, and dilute ethyl alcohol; and insoluble in petroleum ether, 95% ethyl alcohol, and concentrated ammonium sulfate solutions; 2) It is resistant to 70°C. for 2 hours, and to boiling for a few minutes, but was destroyed by a temperature of 121°C. for 30 minutes; 3) the amylase-inhibiting agent did not pass through a cellophane dialysis membrane; 4) the reaction of salivary amylase with the inhibitor substance is reversible. The former can be precipitated practically free from inhibitor by 70% alcohol.

No physiological significance is attached to the presence of the salivary amylase inhibitor in wheat or wheat flour "when cooked by usual procedures." Pepsin destroys the inhibitor substance.

Kniesner, Albert H., A. M. Mann, and T. D. Spies, 1942. RELATIONSHIP OF DENTAL CARIES TO DEFICIENCIES OF THE VITAMIN B. GROUP. Jour. dent. Res., 21 (3): 259-262.

Lactobacillus counts and pantothenic acid values were determined in the salivas of 51 subjects (aged 4 to 20 years), 41 of whom showed evidence of deficiencies attributable to the vitamin B group. These patients averaged 2.1 dental cavities per mouth, while the 10 patients lacking clinical signs of vitamin B deficiency averaged 6.1 cavities per mouth. Pantothenic acid was present in all salivas tested, the amounts ranging from 0.12 to 0.19 mg./cc. of saliva, in sufficient concentration to permit growth of oral lactobacilli. No appreciable difference was found in salivary pantothenic acid values in patients resistant or susceptible to dental caries: 29 patients having lactobacillus counts below 13000/cc. averaged 0.0880 mg. of acid/cc. of saliva; 22 patients with lactobacillus counts above 30,000, averaged 0.885 mg./cc. Four patients who had treatment for their deficiencies showed no change in their salivary pantothenic acid levels.

Knighton, Holmes T., 1942. EFFECT OF VARIOUS FOODS AND CLEANSING AGENTS ON THE ELIMINATION OF ARTIFICIALLY INOCULATED YEAST FROM THE MOUTH. Jour. Amer. dental Assoc., 29 (17): 2012-2018.

Subjects were required to eat a yeast cake (Fleishman's), distributing the material throughout the mouth with the tongue. They were requested to refrain from eating or drinking for 2 hours. At the end of this time, paraffin-stimulated saliva was collected. Saliva samples were diluted in sterile 0.85% sodium chloride and 0.1 cc. amounts of this mixture were distributed over each of 2 Sabouraud's agar plates. The plates were incubated at 37°C. for 48 hours and colonies containing yeast were counted and multiplied by the dilution factor. Three tests were made on separate days and the average of these tests was taken as the control factor, which represented the number of yeast organisms contained in 1 cc. of the paraffin-stimulated saliva.

The cleansing effect of the following substances was observed as measured by the reduction of yeast cells: toothbrush and toothpaste, apple, paraffin, chewy candy, orange (sliced), orange (spooned), banana, and gum. A total of 210 tests were made on 10 subjects over a period of 3 months.

It was concluded that although the tests offer only limited information and that no direct interpretation relative to oral diseases can be made

from the results, certain interesting results regarding the value of different agents were observed. Chewing apples, sliced oranges, and paraffin aided the natural cleansing mechanism of the mouth to a greater degree than did the use of other substances tested. The relatively poor showing in the test employing the toothbrush may be due to the fact that the results for the series as a whole were based on the removal of loose particles from the entire mouth, whereas the toothbrush was used only on the teeth and gingival areas.

Knighton, Holmes T., 1953. EFFECT OF PARAFFIN-STIMULATED SALIVA ON THE GROWTH OF ESCHERICHIA COLI. Jour. dent. Res., 32 (5): 660.

Four ml. samples of pooled, paraffin-stimulated saliva of 50 individuals were inoculated with approximately 4,000 *Escherichia coli* cells, incubated, and spread over E.M.B. agar plates. Colony counts after 24 hours of incubation showed that untreated whole saliva inhibited growth in 40 percent of the samples, while whole saliva containing 1 percent glucose inhibited growth in 98 percent of the samples. Whole saliva containing 1 percent peptone and Berkefeld-filtered saliva produced no inhibition. The average increase in *E. coli* counts was noted in each case. No evidence of specific antibiotic effects was observed. It is suggested that a competition for media may be one of numerous factors limiting colonization of transient contaminants in the mouth. (From author's abstract).

Knighton, H. T., 1957. A COMPARATIVE STUDY OF MICROCOCCUS PYOGENES VAR. AUREUS IN SALIVA OF PENICILLIN-TREATED AND NONTREATED INDIVIDUALS. Oral Surg. Oral Med. Oral Pathol., 10 (8): 885-890.

Preliminary comparative culture studies showed the presence of *Micrococcus pyogenes* var. *aureus* in 40 to 52.8% of paraffin-stimulated salivary samples cultured on a high salt-content selective medium, but only in 10 to 17% of duplicate samples cultured on routine blood agar media. Culture of saliva samples and nasal swabs of 53 dental students, and of 55 patients receiving orally 400,000 units of penicillin daily for 6 months, showed *Micrococcus pyogenes* var. *aureus* in the salivas of 67.3% of the patients and of 45.5% of the students. Penicillin sensitivity tests showed 52.9% of the strains of the organism isolated from saliva of the patients were highly resistant and 26.5% moderately resistant to penicillin, whereas 6.4% of strains in saliva of the students were highly resistant and 23% moderately resistant to the antibiotic. The salivary population of the organism was found to be a very small part of the total aerobic oral flora. Comparative incidence of the organism in nasal and salivary cultures is reported and discussed.

Knorr, M., 1943. BAKTERIONOXINE UND LYSINE IN DER MUNDHÖHLE UND IHRER FLÜSSIGKEIT. ["Bakterionoxines" and lysin in the oral cavity and in its fluids]. Arch. Hyg. und Bakteriologie, 131 (3): 104-133.

The oral antibacterial effects of "bakterionoxines," a collective term used by the author to include important germicidal substances in the oral cavity such as endolysin and lysozyme, was studied in relation to bacteriophage. Evidence of a bacteriophage was noted in the oral flora of one case of diphtheria among various diseased

subjects examined. The antibacterial effects of the bacteriophage were secondary to the effect of the bacterionoxine and were conditioned by it. The oral presence of coli bacteriophage could be detected by culture methods only for two to three days after an oral rinse with bacteriophage broth. Both the exogenous coli bacteria and the bacteriophage were eliminated mechanically from the mouth by oral fluids as their proliferation was stopped by the bacterionoxine.

Knox, K. W., and J. L. Still, 1953. OBSERVATIONS ON THE SALIVARY MUCOIDS. Jour. dent. Res., 32 (3): 379-385.

The ACRA method (congo red in acid alcohol) was used to determine the mucoid content of saliva and it was found that the titer varied considerably in one individual throughout the day. Precipitation of the mucoids of saliva with ammonium sulfate, weak acid, acetone, and alcohol was studied and citric acid was found most suitable as it gave the highest yield of floating precipitate. A comparison of the properties of the mucoids in whole saliva with the mucoid preparation obtained with citric acid indicated that they differed in heat resistance and in precipitability by weak acids. Dialysis lowered the buffering capacity of the mucoid preparation and enzyme depolymerization raised it. Analysis of the mucoid preparation showed it to contain 7.0 percent total nitrogen and 34 percent hexosamine.

Knox, K. W., 1953a. OBSERVATIONS ON THE ACTION OF MUCOLYTIC ENZYMES ON SALIVARY MUCOID. Jour. dent. Res., 32 (3): 374-378.

A study was made of the action of salivary mucolytic enzymes on carbohydrates and the total carbohydrate and reducing sugar liberated have been estimated. All preparations of salivary mucinase showed α -amylase activity. Hyaluronidase was present but lysozyme and trypsin could not be detected. These enzymes were tested for mucolytic activity and trypsin was the only one that decreased the viscosity of the mucoid preparation and it also depolymerized ovomucin. Hyaluronidase was shown to liberate reducing sugar from the depolymerized mucoid.

It is suggested that a proteolytic enzyme decreases the viscosity of salivary mucoid after which an enzyme like hyaluronidase liberates the components of the mucopolysaccharide. Other enzyme components of the mucolytic enzyme system probably help complete depolymerization.

Knox, K. W., 1953b. OBSERVATIONS ON THE SALIVARY MUCOLYTIC ENZYMES. Jour. dent. Res., 32 (3): 367-373.

A study was made of the variation in enzyme concentration in saliva, the preparation and properties of the enzyme, and the occurrence of mucolytic microorganisms. Enzymatic activity was measured by three methods; decrease in ACRA titer, decrease in precipitable mucoid, and decrease in viscosity. The enzyme action was found to vary at different times during the day, from day to day, and from person to person. The salivary mucinase was partly purified by precipitation and adsorption and its properties investigated. The enzyme is inactivated below pH 4.5 and above pH 11.0; heating for two minutes at 55° C also inactivates it. Magnesium acts as an activator for the enzyme. Several organisms with mucolytic

activity were isolated from saliva. These include: a gram-positive rod resembling *Bacillus subtilis*, a gram-positive coccus resembling *Streptococcus*, a gram-positive coccus resembling *Staphylococcus*, and two gram-negative rods. An exocellular mucolytic enzyme was demonstrated but mucolytic activity varied for each strain of organism. Attempts to increase the activity were unsuccessful.

Kocherga, D. A. and V. N. Serbeniuk, 1953. O REFLEKTORNYKH VLIĖNIĖĖKH S ZHELUDKA NA DEĖATEL'NOST' SLĖNNYKH ZHELEZ [Gastric reflex influences on the function of the salivary glands]. Voprosy Fiziol., 6: 58-67.

The effect of gastric pressure stimulation on unconditioned salivary response to uniform feedings of rusk was studied in 3 dogs having submaxillary and parotid fistulas. Inflation of a 200-300 cc. rubber balloon in the stomach produced an immediate decrease in salivary flow; the depression in flow, reaching up to 60-70% of the normal rate, was reversed after deflation, the normal flow returning after 10 to 15 minutes. Pilocarpine salivation was also found to be affected, in one dog tested, by the prolonged mechanical gastric stimulation which produced increased latency and decreased flow to a lesser extent than with food-stimulated salivation. Salivary response to standard rusk feedings was also found to be depressed by introduction of milk or of various solutions into the stomach in place of the balloon inflation.

Kocour, E. J., and E. A. Zaus, 1940. SALIVARY EXCRETION OF SULFANILAMIDE AND THE ACCOMPANYING EFFECT ON MOUTH FLORA. Jour. dental Res., 19 (3): 319.

"Experiments in which the free and conjugated sulfanilamide of the saliva and blood were compared after daily doses of 60 grains of sulfanilamide over a period of 5 days were conducted on 5 patients at the Cook County Hospital. Also, for a period of 5 days prior to administration, counts of the aciduric and normal flora of the mouth were made. No conjugated sulfanilamide was found in the saliva. All was in the free state. The salivary content was usually less by 1 to 2 milligrams per cent than the blood, but, in occasional specimens, it was approximately that of the blood. The bacterial growth on plain dextrose agar showed no reduction. On the fifth day, however, in 3 of the subjects, the aciduric organisms showed a very definite drop. It was thought that the organisms depressed were yeast, acid streptococci, and staphylococci. As the experiments were not carried beyond the fifth day, one must draw conclusions with reservations as to the fifth day drop in the aciduric organisms." (Complete paper.)

Kocour, E. J., and E. A. Zaus, 1940a. THE EFFECT OF VARIOUS FOODS ON THE BUFFERING POWER OF SALIVA. A PRELIMINARY REPORT. Jour. dental Res., 19 (3): 319-320.

"Non-stimulated saliva was collected at intervals of 1, 2, and 3 hours following various diets. The acid neutralizing power of this saliva was determined by titrating it with 0.020 N lactic acid. The pH of the saliva, during this procedure, was determined by a glass electrode. Titration curves were plotted and the number of cubic centimeters of acid required to reduce 100 cc. of saliva

to a pH of 6 and 5 respectively, was determined. Ninety determinations were made on 2 adult male subjects. We believe that neither the number of subjects nor the available data are sufficient to warrant any definite conclusions. We have found that the saliva produced after the ingestion of a diet rich in carbohydrate required approximately 8 cc. less 0.020 N lactic acid per 100 cc. of saliva to reduce the pH to 6, and 10 to 15 cc. less to reduce it to a pH of 5, than that required to correspondingly reduce saliva produced during the post absorptive state. The saliva produced following the ingestion of a diet rich in fat required approximately 8 cc. more of 0.02 N lactic acid per 100 cc. to reduce it to a pH of 5, than that required to correspondingly reduce saliva produced in the post absorptive state. Protein food (animal protein) apparently has little influence upon the neutralizing power of the saliva. Saliva collected during or shortly after speaking has a lowered neutralizing power." (Complete paper.)

Koehne, Martha, and Elise Morrell, 1934. CONTROL OF DENTAL CARIES IN CHILDREN. Amer. Jour. Diseases Children, 48 (1): 6-29.

The saliva composition of 22 children on various diets was examined; CO₂ and P values were included. Four tables of data are presented.

The relation between diet and chemical composition of saliva was studied. In four groups of children, in which there was a constant excess base intake, the CO₂ capacity values varied from 16.4 to 48.5 cc. CO₂ per 100 cc. saliva. In two groups, in which there was a higher (30%) base intake than in the previous four groups, the CO₂ values varied from 21.4 to 38.8 cc. CO₂ per 100 cc. saliva. Both the Ca and P intake were remarkably constant on all diets. The salivary Ca varied from 3.9 to 7.6 mg./100 cc.; the salivary P, from 9.5 to 15.5 mg./100 cc.

The greater part of the paper deals with the correlation of saliva composition (chemical and microbial) with the susceptibility and presence of dental caries.

Koehne, Martha, R. W. Bunting, and F. P. Hadley, 1934a. A REVIEW OF RECENT STUDIES OF THE CAUSE OF DENTAL CARIES. Jour. Amer. dietet. Assoc., 9 (6): 445-461.

A literature review is presented which emphasizes the role of diet in the etiology and prevention of tooth decay, and which discusses saliva in its relation to susceptibility to the condition.

Koehne, Martha, and R. W. Bunting, 1934b. STUDIES IN THE CONTROL OF DENTAL CARIES. II. Jour. Nutri., 7 (6): 657-678.

A study was made of 169 girls and boys over a period of 1-4 1/2 years to determine the relationship between diet or nutrition, and the occurrence of dental caries, as well as a possible correlation between *Bacillus acidophilus* [*Lactobacillus a.*] presence, CO₂ combining power of saliva, height, and weight, and caries susceptibility. An 84% correlation was found to exist between dental caries and the incidence of salivary bacteriological (*B. acidophilus*) findings, but no significant results could be detected between the available base value of the diet or caries susceptibility, and salivary alkaline reserve. It was postulated, from experimental indications, that, perhaps, a

low refined sugar intake, and a regularly prepared and received diet prevents caries occurrence.

Koeniger, Hermann, 1900. UNTERSUCHUNGEN ÜBER DIE FRAGE DER TRÖPFCHENINFECTION [Studies on the question of droplet infection]. Zeitschr. f. Hyg. u. Infektionskrankh., 34 (1): 119-168.

The transmissibility of infectious diseases was studied in a series of 41 experiments. The mouths of test persons were inoculated with *Bac. prodigiosus* [*Serratia marcescens*] or *Bac. mycoides* and the dissemination of droplets by coughing, sneezing, or speaking was determined by culture plates placed at various points of the room.

General conclusions are as follows: The number of droplets expelled in speaking varies directly with the clarity of enunciation, of the consonants in particular. Although there are usually more droplets expelled in loud than in quiet speaking or whispering, the reverse may be true when consonant enunciation is more precise in the latter. The rapidity of speech has no effect on droplet expulsion. Contrary to previous literature, transmission may extend over several meters distance, the droplets remaining air-borne from 1/2 to 3/4 hour in still air and from 1 to 1-1/2 hours in a slight current, depending on the size of the droplet and the strength of the air current. While it is generally believed that humidity has a marked influence on the duration of air-borne droplet suspension, no significant changes occurred when the humidity was raised from 40-75% to 80%.

In coughing and sneezing, the number of expelled droplets and the distance traveled was much greater than in speaking, while the duration of suspension was comparable to that in speaking.

All data are tabulated in detail.

Kolas, S., 1955. INVESTIGATION OF NORMAL HUMAN SALIVA FOR POSSIBLE ANTICARCINOGENIC ACTION AND CHEMICAL CARCINOGENESIS IN MUCOUS MEMBRANES. Oral Surg. Oral Med. Oral Pathol., 8 (11): 1192-1203.

Thorough wetting of skin areas of 32 Swiss mice twice weekly with normal human saliva had no inhibitory effect on tumors produced by application of 3 drops of a 5% solution of 20 methylcholanthrene to the skin areas one day after wetting. Both the experimental animals and 18 control animals, treated with saline instead of saliva, developed squamous-cell carcinoma; a slight increase in interval between application of the carcinogen and appearance of acarcinomas in the saliva-treated animals is not considered significant. The effects of saliva in experimental failure to produce intra-pouch or intraoral tumors by chemical carcinogenesis are discussed.

Koldajew, B., and N. S. Pikul, 1929. UBER DIE LIPOLYTISCHE WIRKUNG DES SPEICHEL [On the lipolytic effect of saliva]. Biochem. Zeitschr., 212 (1-3): 53-60.

The salivary and submaxillary glands of dogs were fistulated according to Pavlov's method. Stalagmometry was used to determine the lipolytic action of the saliva. In the parotid there was a considerable lipolytic action against synthetic fats (tri- and monobutylin, as well as against natural fats (olive oil). The lipolytic action of the submaxillary gland was somewhat less. The lipolytic effect disappeared following boiling of

the saliva. The optimum lipolytic activity occurred at pH 7.6 to 7.8. This value seemed to be independent of the amylolytic enzyme content of the saliva. Saliva stimulated with various food items (fat, meat, bread) had identical lipolytic power. No lipolytic action was detected, however, in the secreted parotid saliva following ingestion of a weak hydrochloric acid solution.

Koldaev, V. M., and N. S. Pikul', 1929. O LIPOLITICHESKOM DEISTVII SLIUNY. [On the lipolytic activity of saliva]. Zhur. eksper. Biol. Med., Moskva, 13 (35-36): 36-41

The salivas of 2 dogs, having parotid and submaxillary fistulas, were tested for lipolytic activity against various dilutions of tributyrin. The saliva-tributyrin mixtures, with thymol added, were incubated for 3 hours at 37°C to determine presence and extent of fat-splitting. Both parotid and submaxillary food-elicited saliva were found to show definite but variable lipolytic activity, with parotid saliva always showing 2 to 3 times greater activity than mixed. Heating at 100°C removed the lipolytic action on tributyrin. Diets of meat, bread, or animal fat effected no salivary change in this activity but it was insignificant or absent in saliva secreted after oral stimulation with weak hydrochloric acid. Optimum lysis was found to occur at pH 7.6 to 7.8. Further tests showed the parotid and mixed salivas to produce a small amount of lipolysis in mixtures of 1% monobutyrin or olive oil emulsion.

Komarov, S. A., and G. W. Stavsky, 1940. THE NITROGENOUS CONSTITUENTS OF CAT'S SUBMAXILLARY SALIVA EVOKED BY PARASYMPATHETIC AND SYMPATHETIC STIMULATION. Canad. Jour. Res., Sect. D, 18 (6): 233-247.

The chorda tympani and cervical sympathetic nerves of nembutal-anesthetized cats were bilaterally sectioned and the submaxillary ducts cannulated. Adrenaline was occasionally intravenously administered as a substitute for sympathetic stimulation.

Salivary protein from the parotid gland and that resulting from chorda and sympathetic stimulation of the submaxillaries was precipitated, and the solubility and resultant viscosity of the precipitate in various solutions were noted. Observations indicate that the protein fraction obtained from the parotid glands was different from that of the submaxillaries, and that the latter's protein belonged to the glycoproteins which is the only type of protein present in submaxillary secretion. Chorda and sympathetic salivary samples show definite differences in chemical and viscosity properties.

Three main fractions of non-protein nitrogens were examined: urea nitrogen, "creatine bodies fraction," and unidentified nitrogen. Of the three, the urea nitrogen was found to be of greatest abundance. Successive salivary samples, resulting from chorda stimulation, reveal that the total protein nitrogen and the three main fractions are reduced, with the urea content being decreased the least and the unidentified nitrogen being decreased the most. The authors contribute the resultant effects of chorda excitation to decreased cell membrane permeability.

Adrenaline stimulation increases the glandular permeability to all of the major fractions, especially to urea; adrenergic effects continue to

be active after the withdrawal of the stimulus and during subsequent chorda stimulation.

It is concluded that changes in the composition of the salivary gland secretion are dependent upon the molecular size of the salivary constituents, and are due to changes in the permeability of the cellular membranes of the gland.

Kopatschek, Federico, and Santiago Videla, 1938. ESTUDIO DE ALGUNAS PROPIEDADES DE LAS DIASTASES SALIVALES [Study of some properties of salivary diastases]. Rev. sud-amer. de Endocrinol., 21 (8): 510-530. In Spanish only.

Human mixed saliva, after addition of known quantities of acid or alkali and dilution with physiological saline solution, was allowed to act on a starch solution. The amount of hydrolysis was determined colorimetrically by the iodine method. Detailed results are presented on p. 512-519 and 523-528. The salivary amylase proved to be relatively resistant to inorganic and organic acids and to alkalis. It is inactivated by heating at 60-65°C. Saliva contains, besides ptyalin, a certain amount of pancreatic amylase which resists temperatures up to 100°C.

Kopeloff, Nicholas, 1921. THE BACTERIAL CONTENT OF THE STOMACH AS INFLUENCED BY SALIVA. Proc. Soc. exper. Biol. Med., 19 (3): 110-112.

The effect of saliva upon the bacterial content of the stomach was studied in a manic-depressive patient; method is fully described. When saliva was not removed, the bacterial counts ranged from 5 to 48,000 and from 12 to 6,800 bacteria/cc. over two 2-1/2 hour observation periods; when saliva was removed, the count ranged from 0 to 32 bacteria/cc. pH had no significant influence; in the absence of saliva, the bacterial count was 2 over a wide range of total acidity. Similar results were obtained with a healthy individual and with other psychotics having very low acidity.

Kopeloff, Nicholas, M. Harris Meyer, and Barbara McGinn, 1932. LYSOZYME IN SALIVA. Amer. Jour. med. Sci., 184 (5): 632-637.

The salivas of 14 postencephalitic patients, 2 general paralytics, 1 acute encephalitic, and 14 normal individuals were tested for lysozyme activity against *Micrococcus lysodeikticus*; procedure is fully described.

In contrast to the findings of Penrose (1930m), no differences were observed between the lysozyme contents of post-encephalitic and normal persons.

The accuracy of the test was not influenced by the age of the culture nor the incubation period within limits (48 hr. strains of 5 month cultures were employed in some experiments), but was influenced by the composition of the medium—the cultures of *M. lysodeikticus* grown on beef extract agar were more susceptible to lysis than were those grown on casein digest agar.

Koranyi, Andreas, E. Szablics, and T. Szenes, 1936. ÜBER DIE BLUTZUCKERSTEIGERENDE WIRKUNG DES MENSCHLICHEN SPEICHEL [On the glycotropic action of human saliva]. Zeitschr. f. d. ges. exper. Med., 97 (4-5): 508-513.

The effect of injection of human saliva on the blood sugar level in rabbits was studied. Intravenous injections of human saliva (amount not given) into 5 rabbits caused increases in

blood sugar values within 5 minutes after injection; in some instances there was a preliminary decrease. The maximum blood sugar values (samples taken at 5, 20, 35, and 60 minutes and even 2-3 hours after injection) occurred within the first hour.

30 units of insulin were administered intravenously and produced pronounced hypoglycemia and also induced severe hypoglycemic cramps. When 5 cc. of saliva were injected intravenously 30 minutes thereafter, the blood sugar level began to rise within minutes and attained its original level within 10-15 minutes; all cramps ceased.

After simultaneous intravenous injection of insulin (30 units) and saliva (5 cc.), one or the other effect may predominate. Apparently, the two substances do not inhibit each other.

The apathy and muscular weakness which developed in all the animals within 35-40 minutes after salivary injection was attributed to muscle glycolysis; small doses of insulin seemed to improve the condition, but it was impossible to attribute the improvement definitely to the insulin, since the animals usually improved of themselves within 10 - 15 minutes.

When salivary injection was combined with muscle excisions, the blood sugar values were much higher than the sum of excess sugar produced by the two procedures performed separately.

Koraskov, I. V., 1931. *O PROISKHOZHENII ZUBNOGO I SLIUNNOGO KAMNIA V SVIAZI S ISSLEDOVANIAMI SMESHANNOI SLIUNI NA KALTSII* [On the origin of the dental and salivary calculi in connection with analyses of mixed saliva for calcium]. *Sovetsk. Stomatologiya*, 9 (11-12): 45-51.

The calcium content of mixed saliva was studied in 33 individuals, 22 with a large calculus deposit on the teeth and 11 without. Samples of saliva were collected before breakfast, centrifuged, the liquid treated by the de Vaard method, and its calcium content calculated in mg./100 cc. The average content (approximately 7.00 mg./100 cc.) was found to be the same in both categories, and in smokers as well as in non-smokers.

Korchin, B., and A. L. Winsor, 1940. *RELATIONSHIP OF CERTAIN ORGANIC FACTORS TO INDIVIDUAL DIFFERENCES IN HUMAN PAROTID SECRETORY RATE*. *Jour. exper. Psychol.*, 27 (2): 192-194.

A study was made of the relationship of weight, height, age, pulse rate, and diastolic or systolic blood pressure to individual differences in parotid reactions. One hundred and twenty-three subjects of both sexes, aged 12 to 49 years, were used in the study. Results indicated that variations in parotid secretion did not appear to be related to any of the factors studied.

Koropov, V. M., 1939. *VLIYANIE UDALENIYA IAKOBSONOVA NERVA I VERKHNEGO SIMPATICHESKOGO UZLA NA SEKRETOVNUIU FUNKTSIU OKOLOUSHNOI SLIUNNOI ZHELEZY SOBAKI* [The influence of extirpation of Jacobsen's nerve and superior sympathetic ganglion on the secretory function of the parotid salivary gland in the dog]. *Fiziol. Zhur. SSSR*, 27 (2): 156-164.

Reflex and automatic parotid secretion was studied after sympathetic denervation and extirpation of the tympanic nerve. Experiments were made in several fistulated dogs. Salivary secretion in response to food (rusk powder, milk), acid

(30 cc. of a 0.5% HCl solution) and to pilocarpine (0.6 cc. of a 0.5% solution) were first studied. After stimulation per os the saliva was collected every minute, after pilocarpine, every 15 minutes during 2 hours, and the amount of secretion, dry residue, and organic and inorganic content measured. The operation was then undertaken under morphine-ether-chloroform anesthesia: in some dogs the tympanic nerve was extirpated first, with all its branches, and, after the animal's recovery, the upper neck ganglion excised; in the others, the salivary gland was desympathized first, then deprived of its parasympathetic innervation. Salivary secretion in response to the same stimuli was retested.

After the extirpation of the tympanic nerve, the results obtained in 2 dogs corresponded to Andreev and Podkopaev's findings (1928): the reflex salivary secretion diminished from 10 to 20 times in the first days, and stayed at this level for 2 to 3 months, then started slowly to increase. In 4 other dogs, the reflex salivary secretion remained absent from 41 to 110 days, then reappeared at a greatly reduced rate during 1.5 to 2 months; finally returned slowly to normal [after 4 months].

Automatic pilocarpine secretion, observed in some cases during a year or longer, remained, in the majority of animals, at the same level after the extirpation of the nerve, and increased on certain days in others; it fluctuated below normal only in one. Thus, a unilateral nerve resection does not decrease automatic salivation on the opposite side. (This contradicts the results of Andreev and Podkopaev who experimented in only one dog.)

After subsequent extirpation of the upper neck ganglion, results obtained in all the dogs showed no cessation of the reflex salivation; the secretion remained at the same level, except in one animal, where a slight decrease was noted. Automatic pilocarpine salivation was not altered after this operation.

Another series of experiments, with a reversed sequence of operations (desympathization, followed by the excision of the tympanic nerve), resulted, in the majority of animals, in absence of reflex salivation during a long period of time (up to 150 days); then the reflex salivation reappeared, but remained at a much lower level than before the operation. In a few animals the reflex salivation set in during the first days after the operation.

Automatic pilocarpine secretion remained after this operation on the pre-operative level during a long time in some animals, and increased in others.

After complete denervation, the dry-residue percentage in pilocarpine-stimulated saliva is increased, due to its increased organic matter content.

The author concludes that extirpation of the tympanic nerve in desympathized animals produces the same changes in parotid salivary secretion as in non-desympathized animals. These data do not confirm the supposition (Andreev and Podkopaev, 1928) that the restoration to normal of the parotid reflectory secretion after extirpation of the tympanic nerve is due to a switch to parasympathetic function in an increasing number of sympathetic fibers.

Koropov, V. M., 1940. *ACTION OF ADRENALIN ON THE SECRETORY ACTIVITY OF THE DENERVATED PAROTID*

GLANDS IN THE DOG. Bull. Biol. Med. exper. URSS, 9 (5-6): 455-458.

Parotid secretion under the effect of adrenalin was studied in three groups of dogs with chronic fistulas. Sympathetic innervation was excluded in the first group by excision of the superior cervical ganglion, parasympathetic innervation was cut in the second, by section of the tympanic nerve; while the tympanic nerve was resected in the third after excision of the superior cervical ganglion.

Results showed that, while the normal parotid gland secretes up to 3.5 cc. of saliva after injection of 1 cc. of 1:1000 adrenalin, the desympathized gland releases only 1 to 2 drops. No secretion occurs from the parotid gland after parasympathetic or total denervation, indicating that salivation following the injection of adrenalin is due to the action of both the sympathetic and the parasympathetic nerve.

Preliminary injection of 1 cc. of adrenalin has an inhibitory effect on salivation elicited by injection of 0.6 cc. of 0.5% pilocarpine both in denervated and in normal glands. This inhibitory action is usually of short duration and disappears the following day; the inhibitory effect may last 6 days in some animals with a completely denervated gland.

Koropov, V. M., 1940a. VLIYANIE ADRENALINA NA SEKRETOVNUIU FUNKTSIIU DENERVIROVANNYKH OKOLOUSHNYKH ZHELEZ SOBARI. SOOBSHCHENIE I. [The influence of adrenalin on the secretory function of the denervated parotid gland in the dog. Communication I]. Biull. eksper. Biol. Med., Moskva, 9 (5): 368-372.

Russian version of Koropov (1940m).

Koropov, V. M., 1947. MATERIALY PO IZUCHENIIU ROLI NERVOI SISTEMY V PATOGENESE VOSPALENIYA. SOOBSHCHENIE I. VLIYANIE VOSPALENIYA NA SEKRETOVNUIU FUNKTSIIU INTAKTNYKH I DESIMPATIZIROVANNYKH OKOLOUSHNYKH SLIUNNYKH ZHELEZ [Contribution to the study of the role of the nervous system in the pathogeny of inflammation. Communication I. The influence of inflammation on the secretory function of intact or desympathized parotid glands]. Arkhiv Patologii, 5: 59-66. Abst.: Sovet. med. ref. Obozrenie, Fiziol., 1949 (4): 92.

Salivary changes under the influence of salivary gland inflammation were studied in dogs having parotid fistulas. Aseptic inflammation was produced by introduction of infusorial earth into the parotid glandular tissue, septic inflammation by injection of an emulsion of staphylococcus or of streptococcus. Desympathization was effected by excision of the superior cervical ganglion. Results showed that desympathization of the inflamed gland has no substantial influence on the secretion. The principal differences in the changes of secretory function are absent; only some quantitative displacements exist, expressed in a change in duration of secretory restoration and a change in the rate of salivation.

Koropov, V. M., 1948. MATERIALY PO IZUCHENIIU ROLI NERVOI SISTEMY V PATOGENESE VOSPALENIYA. SOOBSHCHENIE 2. VLIYANIE VOSPALENIYA NA SEKRETOVNUIU FUNKTSIIU OKOLOUSHNYKH ZHELEZ, LISHENNYKH PARASYMPATICHESKOI INNERVATSII I POLNOST'IU LISHENNYKH NERVNYKH SVYAZEI. [Contributions to the study of the role played by the nervous system in

the pathogeny of inflammation. Communication 2. The influence of inflammation on the secretory function of parotid glands which are deprived of parasympathetic or of all innervation]. Arkhiv Patologii, 4: 27-32. Abst.: Sovet. med. refer. Obozrenie, Fiziol., 1949 (4): 93.

Parotid secretion, after either parasympathetic or complete denervation of the gland, was studied in dogs having experimentally-induced parotid gland inflammation. Results showed that aseptic inflammation of the parasympathetic denervated gland produces a greater depression in function and a reduction in recovery time than similar inflammation of the intact gland; these differences did not occur with septic inflammation. Aseptic inflammation also produced a sharp decrease in salivation from the completely denervated gland. The author concludes that the nervous system is not primarily involved in secretory changes during induced parotid gland inflammation, as substantial changes are quantitative rather than qualitative.

Koropov, V. M., 1950. O VOSSTANOVLENIU FUNKTSII OKOLOUSHNOI SLIUNNOI ZHELEZY POSLE CHASTICHNYKH RESEKTSII [On the restoration of function in the parotid gland after partial resection]. Arkhiv Patologii, 1: 22-29. Abst.: Sovet. med. refer. Obozrenie, Fiziol., 1952 (9): 89.

Parotid secretion in response to pilocarpine, food, or chemical stimuli was studied in dogs before and after resection of the postauricular portion of the parotid gland. Results show a three-stage process of recovery similar to that occurring in cases of parotid inflammation: more or less salivary inhibition, an increased secretion, then a return to normal. Salivary inhibition may be gradual, with minimum secretion after 3 to 5 days, or may set in on the day following resection. Recovery time was extended with increase in the degree of salivary inhibition. Considerable individual variation was observed in the duration of the recovery period. The dry residue content of the saliva increased for a short time after partial glandular resection, apparently as a result of inflammation exudate included in the secretion.

Koropov, V. M., 1953. INTEROTSEPTIVNYE SVYAZI MEZH DU ZHELUDKOM, PROAZHENNYM VOSPALITEL'NYM PROTSESSOM I SLIUNNYMI ZHELEZAMI [Interoceptive relationship between the stomach, affected by an inflammatory condition, and the salivary glands]. Trudy Moskov. Veterin. Akad. Ser. A, 8: 147-158. Sovet. med. refer. Obozrenie, 1954 (19): 78.

Salivary secretion was studied in dogs having parotid and gastric fistulas after gastric fistular injection of one liter of water at 60-66°C. for 1.5 to 2.5 minutes. Spontaneous salivation, lasting 5 to 12 minutes, and a 1.0 - 1.5° rise in body temperature followed injection. Injection of pilocarpine, 10 to 15 minutes after the gastric injection, showed a 50 - 70% decrease in salivation during the subsequent 2 to 5 days. No relation was found between decrease in salivation and severity of gastric mucosa inflammation produced by repeated gastric injections. The gastric inflammation is considered to affect interoceptive impulses to the central nervous system, resulting in a change in centrifugal impulses to the salivary glands.

Koropow, W. M., 1934. ÜBER DIE SEKRETIONSTÄTIGKEIT DER SPEICHELDRÜSEN IM FIEBERZUSTAND [On the secretory activity of the salivary glands during fever]. Naunyn-Schmiedeberg's Arch. exper. Pathol. und Pharmakol., 175: 156-164.

A study is reported of salivation in fistulated dogs during fever induced by injection of one to 3 cc. of turpentine oil; salivary secretion was determined during various phases of the fever. The function of the lower cerebral area, the bulbar center conditioning the salivary secretion, was not affected by oral stimulation with hydrochloric acid or ingestion of milk by the febrile dogs; subcutaneous injection of 10 mg. of pilocarpine evoked salivation lasting 2 to 2-1/2 hours, fluctuations in the amount of secretion remaining within normal limits. Functions of the higher cerebral areas affecting salivation were greatly inhibited; the inhibition of the conditioned salivary reflex persisted for several days after cessation of the fever.

Korsakov, I. V., 1931. PROISKHOZHDENIE ZUBNOGO I SLIUNNOGO KAMNIA V SVYAZI S ISSLEDOVANIAMI SMESHANNOI SLIUNY NA KALTSII [The origin of the salivary calculus in connection with the analysis of mixed saliva for calcium]. Sovet. Stomatologia, 10: 45-51.

The calcium content of saliva was determined in 33 subjects, with or without extensive dental calculus deposits. Six to 10 cc. samples of saliva were collected in the morning, after mouth-rinsing and before breakfast, and the calcium content as mg./100 cc. determined by the Vaard method: a saturated solution of ammonium bioxalate was added to 2 cc. of saliva, the calcium precipitate washed thrice with water plus sulfuric acid and titrated with potassium permanganate. In cases of a saliva very rich in mucin, a few drops of ammonia had to be added, or the saliva was kept at 37° C. The 33 subjects were divided into two groups: 11 without dental caries or calculi to establish a normal standard, and 22 with high calculus deposits, where dental caries was also present.

The tabulated results show no difference between the calcium content of the mixed saliva of the 2 groups; neither could any difference be found in the calcium content of the saliva of smokers or non-smokers.

Kortuem, Cecelia M., 1944. SALIVA GLUCOSE: A QUANTITATIVE METHOD FOR ITS DETERMINATION IN YOUNG CHILDREN. Amer. Jour. Clin. Pathol., 8 (4): 70-74.

A method is presented in detail, for the quantitative determination of glucose in the saliva, based on tests using the saliva of 31 healthy infants ranging in age from 15 to 40 months. The salivary glucose level rose, after the ingestion of dextrose in accordance with the Exten-Rose method, from a mean of 10.6 mg. glucose/100 cc. saliva (after fasting for 14 hours) to 51.8 mg. at the end of 1 hour. The level fell to 21.3 mg. 15 minutes later.

Koser, Stewart A., and Barbara Jane Fisher, 1950. VITAMIN REQUIREMENTS OF ORAL LACTOBACILLI. Jour. dental Res., 29 (6): 760-773.

Twenty-six strains of oral lactobacilli from saliva of carious lesions (11 stock and 15 recently isolated) were seeded on a basal medium

(casein digest, glucose, acetate, or citrate and inorganic salts) unsuitable for their growth. The needs of the microorganisms were determined by adding various combinations of vitamins to the medium. All of the lactobacilli required nicotinic acid, pantothenic acid, and biotin; many required either pteroylglutamic acid, pyridoxamine, or both; 8 strains required thiamine and not riboflavin and 17 strains, riboflavin, and not thiamine. The need for thiamine indicated a heterofermentative type of glucose metabolism. No essential difference was observed between the vitamin requirements of the stock and of recently isolated strains. The addition of either purines or pyridines often produced accelerated growth. The acceleration was greater when the substances were applied in combination than when applied individually.

Koser, Stewart A., Barbara Jean Fisher, and Shirley L. Kauffman, 1951. GROWTH AND ACID PRODUCTION BY ORAL LACTOBACILLI IN THE PRESENCE OF VARYING AMOUNTS OF REQUIRED VITAMINS. Jour. dental Res., 30 (4): 532-541.

Varying amounts of vitamins needed for the growth of oral lactobacilli in amounts ranging from suboptimum to quantities sufficient for maximum growth were added to a basal medium of casein digest, glucose, and salts. Turbidity, pH, and titratable acid were measured.

Acid production (about pH 4.0) and maximum (or practically maximum) growth occurred when the following vitamin amounts were present: biotin, 0.0003 micrograms/milliliter of medium; nicotinic acid, 0.05; calcium pantothenate, 0.03-0.1; riboflavin, 0.03; pteroylglutamic acid (folic acid), about 0.01; pyridoxamine hydrochloride, 0.3 to 1.0; pyridoxal hydrochloride 0.03-0.3; and thiamine hydrochloride, 0.01 to 0.03 micrograms/milliliter medium. Allowances were made for differences between strains.

Lesser growth and acid production were supported by smaller amounts of vitamins, generally in proportion to the amount of vitamin supplied. Slight amounts of vitamins generally supported detectable acid production.

The author assumes that saliva frequently contains vitamin requirements for maximum, or near maximum growth, of oral lactobacilli.

Koser, Stewart A., and Shirley L. Kauffman, 1952. THE AMOUNT OF FOLIC ACID IN SALIVA. Jour. dental Res., 31 (4): 468.

"By microbiologic assay it was found that the amount of free folic acid (pteroylglutamic acid) plus any substances with folic acid activity averaged 0.024 micrograms per ml. of saliva. This figure was the average of 51 separate determinations on saliva specimens from 20 persons, mostly young adults. Most of the values fell between 0.008 and 0.039 micrograms per ml., with extremes of 0.003 and 0.075 micrograms per ml. In testing the accuracy of the assay method, satisfactorily uniform values could be obtained on different amounts of the same saliva specimen, and folic acid added in known amounts to specimens could be detected within the usual limits of accuracy of a microbiologic method." (Complete paper.)

Kosiakov, P. N., G. V. Morozov, V. E. Roxhnov, 1954. O KORKOVOI REGULIATSII ANTIGENNOI FUNKTSII

SLIUNNYKH ZHELEZ CHELOVEKA [On the cortical regulation of antigen production in the salivary gland of man]. Zhur. vysshei nerv. Deiatel'nosti, 2: 166-176. Abst.: Sovet. med. refer. Obozrenie, Fiziol., 1956 (25): 17.

Cortical regulation of antigen production by salivary glands was studied in four chronic alcoholic patients receiving hypnosis therapy. The salivary content of group antigen A and B was determined before treatment, during the progress of deep hypnotic sleep, and 10 minutes after awakening. The salivary titer of samples collected during deep hypnotic inhibition was notably lower than that in pre- or post-treatment samples which were usually similar in titer; considerable individual fluctuation in agglutinin activity was noted in salivary samples collected at various sittings. Control tests for the measurement of salivary albumin in samples from the same subject collected under different circumstances showed that the changes in antigen titer cannot be explained by decrease in salivary concentration but depend on the actual change in antigen production. An increase in the salivary group antigens occurred when some negative emotion was suggested to a hypnotized subject, such as an impulse for nausea, producing subcortical stimulation.

Kostenetskaya, N. A., 1940. KORKOVOI KOMPONENT BEZUSLOVNOI PISHCHEVOI REAKTSII I DEIATEL'NOST' KORKOVOGO PISHCHEVOGO TSENTRA [The cortical component of the unconditioned food reaction and function of the cortical food center]. Biull. eksper. Biol. Med., Moskva, 10 (1-2): 90-92.

The function of the cortical food center in salivary secretion during unconditioned response to food was studied in one dog stimulated by 6 oral administrations of a 40% sugar solution at 50 cc./minute. Each administration was preceded by a 20-second period of conditioned stimulation. The oral stimulation in the first experiments produced a low rate of salivary secretion of around 20 units to the first administration, often decreasing to no response to the last administration. This unconditioned response increased to 70 units/minute on the first appearance of a conditioned salivary response; the unconditioned response was unchanged if only the oral stimulation was applied. After establishment of differential conditioned response to sound, the passage from secretion-inhibiting to secretion-stimulating sound stimuli with subsequent sugar administration, produced an increased unconditioned salivation. Application of the inhibiting sound-stimulus with reinforcement by the usual amount of sugar solution evoked considerably less salivation than the reinforced positive sound-stimulus. The latter, applied without reinforcement, showed no change in salivation rate during the first 20 seconds then dropped during the following minute to 60% of the previous rate of secretion. Results indicate that inhibition of salivary secretion occurs in the cerebral cortex; the presence is assumed of a functional food center in the cortex.

Kostuch, Z., 1938. FERMENTS ANTI-GROUPAUX DU BACILLUS PERFRINGENS. [Anti-group enzymes of B. perfringens]. Compt. rend. Soc. Biol. (Paris), 129: 352-354.

Saliva from individuals with A, B, or O blood types was used as antigen to test the anti-group

activity of Bacillus perfringens [Clostridium perfringens]. The organisms were seeded in pure Wrzosek-Tarozzi media or in such media containing 0.1 to 0.5 cc. of the respective test salivas, and covered with paraffin. Bacillus perfringens destroyed the A, B, and O group elements contained in the salivas in 9 of 16 experiments.

Kovyrev, I. G., 1941. GUMORAL'NOE VLIYANIE RAZDRAZHENIYA CHORDAE TYMPANI NA VNESHNIYU SEKRETSIU PODZHELUDCHNOY ZHELEZY [The humoral influence of stimulation of the chorda tympani on the external secretion of the pancreatic gland]. Fiziol. Zhur. SSSR, 30 (3): 366-373.

Vigorous chordal stimulation after ligation of the submaxillary ducts, in dogs having a cannulated pancreatic duct under morphine-ether-chloroform anesthesia, produced no increase in the inhibition of pancreatic secretion produced by the chordal stimulation. Intravenous injection of 0.2 to 0.5 cc./kg. of chordal saliva resulted in death of 3 animals; similar injections, with the saliva diluted 50% with physiological solution produced a prolongation of the lag period and a sharp reduction in pancreatic secretion, indicating the presence of a chordal substance in the injected saliva. Intravenous injection of 0.5 mg./kg. of atropine did not alter the depressing effect on pancreatic secretion produced by chordal stimulation or injection of chordal saliva. Injection of 0.25 to 0.5 mg. of histamine, followed by injection of secretin, produced no change in pancreatic secretion elicited by the secretin. Intravenous injection of boiled chordal saliva followed by injection of fresh chordal saliva, or vice versa, showed the fresh saliva only to produce the secretory depression. Results indicate the chordal substance in the saliva to be a complicated organic thermolabile substance, not identical with choline or acetylcholine.

Kozlov, I. G., 1955. VLIYANIE VNUTRIBENNOGO VVEDENIYA NOVOKAINA NA USLOVNYE INTEROTSEPTIVNYE REFLEKSY [The influence of intravenous injection of novocain on the conditioned interoceptive reflexes]. Biull. eksper. Biol. Med., Moskva, 40 (7): 47-49.

The influence of novocain on conditioned interoceptive reflexes was studied in 2 dogs with fistulated parotid gland and stomach. The conditioned interoceptive "food" reflex was stimulated by means of stomach inflation; the unconditioned reflex was stimulated by feeding the dogs a moistened rusk-meat powder. Results show that an intravenous injection of 5 ml. of a 1% novocain solution causes the conditioned salivary reflex to disappear and the unconditioned reflex to decrease; the greatest decrease is observed after the 4th injection. The influence of novocain on reflex salivation grew weaker after repeated injections, and on the 3rd or 4th day the secretion rate returned to normal. Repetition of the tests brought a restoration to normal on the second day.

Further experiments were made during 11 days during which the novocain injections were preceded by ingestion of increasing doses (2 to 3 gm.) of sodium bromide in 250 ml. of milk, one hour before experimentation. The conditioned salivary reflex was depressed as after novocain alone. Similar administration of increasing doses

(0.1 to 0.4 gm.) of caffeine likewise produced no change in the depressed conditioned salivary reflex effected by novocain injection. Unconditioned salivary secretion decreased 10 to 15% of the normal rate after the first novocain injection, then returned to normal after 8 to 12 minutes. No substantial change was noted in the unconditioned salivary rate after the 5th and subsequent novocain injections.

Results show that each intravenous injection of a 1% novocain solution causes the disappearance of the conditioned salivary reflex and the decrease of the unconditioned reflex secretion. The occurrence of greater changes in conditioned reflex salivation than in the unconditioned indicates that novocain acts primarily on the cerebral cortex and to a lesser degree on the lower brain portions. [From author's abstract]

Kramer, M., and K. Silberschmidt, 1948. HUMAN SALIVA AS A GERMINATION INHIBITOR. *Science*, 108 (2807): 410.

A discussion is presented on the work of Yardeni [cf. Yardeni, 1948] in which the inhibition of germination produced by human saliva was attributed to the bacteriostatic properties of the saliva. It is suggested that the growth hormone content of saliva might possibly be responsible for the germination-inhibiting effects observed.

Krasnitskii, A. V., 1936. ROTOVYE FISTULY KAK METOD IZUCHENIĖ FIZIOLOGII OKOLOUSHNYKH SLĖNNYKH ZHELEZ U SVINEI [Oral fistulae as a method of studying the physiology of the parotid glands in pigs]. *Fiziol. Zhur.*, 20 (2): 375-387.

The author studied parotid secretion in pigs by means of an oral fistula he had devised, which permits easy access into the animal's oral cavity. It consists of a thickly-walled rubber tube run through the cheek slightly behind the papilla of Stensen's duct and firmly attached on both sides through a tightly fitted rubber disc. The parotid glands were fistulated. Bilateral operation permitted double stimulation and simultaneous observation of both parotid secretions. Food stimuli (vetch, bran, barley mash, lucerne silage, green lucerne, water, milk) and acids (4.5% hydrochloric, lactic, acetic, or formic) were introduced through the rubber tube after an 8 to 10-day postoperative period.

Results showed that the period of latency in parotid secretion is much shorter for stimulation through food than through repellents (acids). It varies however considerably, even for the same stimulus.

There is a marked asymmetry in parotid secretion, both in the period of latency and in the amount of saliva secreted. Usually the right gland reacts quicker than the left. With most foods the left gland secretes considerably more saliva than the right. Sometimes, however, this asymmetry is reversed: silage foods, vetch, milk and acids elicit a considerably greater secretion from the right parotid gland. The author calls this asymmetry functional and selective.

Water usually greatly decreases the amount of salivary secretion; however, injections of 0.025% pilocarpine in a 2.5% solution (to a pig weighing 65 kg.) and subsequent administration of water produced the typical pilocarpine salivation which no amount of water could reduce. The

author concludes therefore that water has no inhibiting influence on salivation; it decreases salivation merely by reducing the mechanic action of the food bolus or, in the case of acids, by washing the stimulus away.

The author observed, that the mechanic action of dry food is the greater, the smaller the particles; thus powdered food elicits much more saliva than large particles, wet pulp elicits the least.

Krasnogorskiĭ, N. I., 1928. DAL'NEISHIE USPEKHI V METODIKE IZUCHENIĖ BEZUSLOVNYKH I USLOVNYKH SLĖNNYKH REFLEKSOV U DETEI [Further progress in the method of study of the unconditioned and conditioned salivary reflexes in children]. *Sbornik po Psikhonevrologii posviashchennyĭ prof. A. I. Iushchenko (iubileinyĭ)*, Rostov on Don, 1928, p. 104-108.

Description is given of a small silver cap, devised by the author for the collection of submaxillary saliva in children. By means of a strong vacuum chamber, closely fitting shape, and a wide surface of adhesion, very strong attachment over the opening of Wharton's duct is made possible, which allows the children to talk and to chew hard food safely during the experimentation. The apparatus is 7 to 11 mm. long, 16 to 25 mm. wide, and 1.5 to 2 mm. high. The measurements of the inner chamber are 3 to 6 by 8 to 12 mm. There is a notch for the frenum linguae.

A systematic comparative study of the parotid and submaxillary unconditioned and conditioned reflexes was made using this device.

Previous observations that the submaxillary gland in man reacts more than the parotid, obtained full confirmation. While a conditioned reflex elicited in toto 1 drop of saliva from the parotid gland, it elicited 16 from the submaxillary.

Further tests showed that the conditioned reflexes form much quicker in the submaxillary gland than in the parotid; when the submaxillary gland was already eliciting 9 drops of saliva, the reflex was still absent in the parotid. In one child, a skin stimulation applied during 20 sec. before the giving of food, produced a conditioned reflex on the twelfth instant, eliciting 18 drops of saliva from the parotid, and 44 drops from the submaxillary gland.

The periods of latency are also much shorter in the submaxillary than in the parotid gland. In the above-mentioned case they were 2.5 and 5.5 sec. respectively.

The author concludes that the submaxillary reflex can compete with the movement reflex in regard to the rapidity of unconditioned reflex formation, and to swiftness of reaction. The author obtained very sensitive conditioned secretory reactions to exterior stimulations. This sensitivity of the submaxillary gland has enabled him to study the secretory reflexes in children whose large hemispherical cortex cells showed a very low capacity of stimulation, and where the conditioned parotid reflex was often completely insignificant.

Moreover, the study of various degrees of viscosity and changing organic composition of the submaxillary saliva, as a result of exterior stimulation, permits further analysis of nervous activity in the child.

Krasnogorski, N. I., 1933. PHYSIOLOGY OF CEREBRAL ACTIVITY IN CHILDREN AS A NEW SUBJECT OF PEDIATRIC INVESTIGATION. *Amer. Jour. Dis. Child.*, 46 (3): 473-494.

The brain or cerebral activities of normal and pathologic children are discussed, and salivary-rate changes are cited as indicators of activity and response manifestations.

Krasnovskaia, L. A., and V. V. Efimov, 1947. VLIĖANIE ANOKSEMII NA POIÄVLENIE TOKSICHESKIKH SVOISTV SLIUNY [The influence of anoxemia on the appearance of toxic properties in the saliva]. *Biull. eksper. Biol. Med.*, Moskva, 24 (1): 104-105.

The appearance of toxic substances in human saliva during anoxemia was investigated in subjects held at simulated altitudes of 1500 to 5000 meters in a barochamber for 30 to 40 minutes. Samples of saliva were collected before and after the reduced pressure periods, and tested for autotoxins by determining the amount of volume contraction produced by a dilute salivary sample on fresh frog-leg muscle, at 3-minute intervals during a 30-minute incubation period at 30°C. Test results show a pronounced toxicity to appear in salivary samples of subjects held at an altitude of 5000 meters; a small amount of toxic substances occur in salivary samples of subjects held at 4000 meters, while none was noted in samples collected from subjects held at 1500-25000 meters.

Krasnow, Frances, 1932. BIOCHEMICAL STUDIES OF DENTAL CARIES: DIURNAL VARIATIONS IN THE PHOSPHORUS, CALCIUM, HYDROGEN-ION CONCENTRATION, AND TITRATABLE ALKALINITY. *Jour. dental Res.*, 12 (3): 530-532.

Stimulated and unstimulated salivas were obtained from each of 25 individuals, 11 caries-free and 14 caries-susceptible persons; 52 determinations were made of the phosphorus and calcium contents, the pH, and the titratable alkalinity of the saliva.

Morning and evening samples were compared. In saliva from both caries-immune and caries-susceptible persons, all values were higher in the evening than in the morning. In the evening, 66% of the caries-immune showed an increase in phosphorus concentration, 71% showed a calcium increase, 57% a hydrogen ion concentration increase, and 66% an increase in titratable alkalinity. For the caries-susceptible individuals, the percentages of cases showing increases were 65%, 73%, 48%, and 68%, respectively.

For the caries-immune individuals, the percentage increases of concentration of phosphorus, Ca, pH, and titratable alkalinity were 17, 17, 1.5, and 33 respectively; for the caries-susceptibles, 16, 11, 2.7, and 27. The percentage of caries susceptible persons having a very small increase in values was greater than for the caries-immune individuals.

In the unstimulated saliva, there was a definite decrease in phosphorus concentration in all the individuals. The decrease in Ca was greater for the caries-susceptibles than for the caries-immunes but, in general, was not so noticeable as the phosphorus change. The hydrogen-ion concentration and the titratable alkalinity were increased after stimulation, the increase in the caries-immune persons being greater than in the caries-susceptibles.

Krasnow, Frances, Maxwell Karshan, and Laura E. Kerjci, 1932a. THE DETERMINATION OF CALCIUM AND PHOSPHORUS IN SALIVA. *Jour. Lab. clin. Med.*, 17 (11): 1148-1152.

A detailed discussion of biochemical methods for determining calcium (Tables I, II, and III) and phosphorus (Table VI) applied to saliva, with a comparison of results obtained on ashed and unashed saliva (Tables IV, V, and VIII).

Krasnow, Frances, and Edith B. Oblatt, 1933. STUDIES OF VARIATION IN SALIVARY PROTEINS. *Jour. dental Res.*, 13 (3): 239.

"Employing the factor, 21—ratio between tyrosine and protein—analyses were made on saliva of caries-immune and of caries-susceptible persons. Frequency curves, used to estimate incidence of values, indicate that (1) a higher salivary protein occurred more often in caries-immune individuals; (2) during the day, salivary protein of caries-susceptibles were subject to less change; (3) on centrifugation, more protein was sedimented from saliva of caries-susceptibles, suggesting that possibly salivary protein of caries-immunes is more stable. There was striking interdependence of protein, P, pH, and titratable alkalinity, in caries-susceptible cases. Incidence of low- or high-protein values varied directly with those for low- or high-P, pH, and titratable alkalinity. Under most favorable conditions for standardization of saliva-collection (i.e., morning unstimulated samples), the correlation was most marked." (Complete paper.)

Krasnow, Frances, 1934. CHOLESTEROL AND LECITHIN IN TEETH AND SALIVA. *Jour. dental Res.*, 14 (3): 226-227.

"Procedures for quantitative determination of lipid-P (alcohol-ether soluble P) and cholesterol in saliva and teeth were devised. In analyses of 40 specimens of saliva, lipid-P ranged from 0.1 to 0.4 mg. per 100 cc.; cholesterol, from 2.0 to 9.0 mg. per 100 cc. Thus far, for teeth, only lipid-P was determined. In enamel and dentin from 15 teeth, content of lipid-P per 100 mg. was 0.5 to 2.8 mg., and 0.1 to 1.7 mg., respectively." (Complete paper.)

Krasnow, Frances, E. B. Oblatt, and V. Rechnitzer, 1935. Dialysis and adsorption studies in salivary calcium, phosphorus, and magnesium. *Jour. dent. Res.*, 15 (3-4): 217-218.

The effects of the dialysis and adsorption of calcium, phosphorus, and magnesium of saliva were studied. All three were found to be equally filtrable, with calcium being withheld to the greatest degree; 35 percent of total calcium withheld compared with 11 percent for phosphorus and 21 percent for magnesium. The percentages adsorbed from saliva using the barium sulfate adsorption tests were inversely proportional to those dialyzed: 81, 67, and 57 percent for calcium, phosphorus, and magnesium, respectively.

Krasnow, Frances, A. S. Rosen, and Y. Porowska, 1935a. THE DETERMINATION OF LIPID PHOSPHORUS. ALCOHOL ETHER SOLUBLE PHOSPHORUS. *Jour. Lab. clin. Med.*, 20 (10): 1090-1093.

A modified method for the determination of the lipid phosphorus of blood, spinal fluid, casein, and saliva is presented and discussed. Analyses of amounts lower than 0.1 percent were duplicated with a good degree of accuracy.

Krasnow, Frances, and Edith B. Oblatt, 1936. ULTRAFILTRATION AND ADSORPTION STUDIES: SIGNIFICANCE OF SALIVARY CALCIUM AND INORGANIC-PHOSPHORUS PARTITION IN RELATION TO DENTAL CARIES. *Jour. dent. Res.*, 15 (5): 366-367.

Previous investigation on fractionation of salivary Ca and P, by ultrafiltration and adsorption, indicated difference in condition of Ca in salivas of caries-free and caries-susceptible individuals. Thus, in 67 percent of former group, less than 50 percent of Ca was ultrafiltered; in 65 percent of latter, more than 50 percent. Difference suggests stable combination of Ca with colloidal component. Stable salivary Ca-proteinate previously suggested, for caries-free persons, on finding more protein remained in supernatant fluid after centrifugation of saliva than before. Present results seem to support this probability. Significant differences in P not found. Adsorption partition tends to depend on adsorbent employed. One specimen of BaSO₄ adsorbed 90 percent of salivary Ca and 56 percent of P; another, 65 percent of Ca and 97 percent of P. Sample of Ca₃(PO₄)₂ composite of twenty-six individual precipitations obtained by mixing Ba(NO₃)₂ and H₂SO₄ under identical conditions--showed tendency to adsorb more ultrafilterable Ca for caries-free series than for caries-susceptible. (Author's abstract)

Krasnow, Frances, and A. S. Rosen, 1936a. SALIVARY LIPID PHOSPHORUS: ALCOHOL-ETHER SOLUBLE PHOSPHORUS. *Jour. dent. Res.*, 15 (5): 368.

Analyses of salivary lipid-P for 80 cases indicated (a) technic employed (*Jour. Lab. Clin. Med.*, 20: 1090, 1935) yielded accurately reproducible results. (b) Concentration ranged from 0.05 to 1.79 mg. per 100 cc. of saliva--55 percent below 0.2 mg. (c) In dento-medical clinically-normal group, low values (0.05-0.20, average 0.16 mg.) appeared characteristic for younger individuals (6 months-20 years); higher figures (0.19-0.48, average 0.29 mg.) for persons above 20. (d) Caries-susceptible subjects at corresponding age-levels showed salivary-lipid-P content within respective limits: 0.09-0.38, average 0.22 mg. and 0.13-0.50, average 0.27 mg., (e) Concentrations above 0.50 mg. obtained in cases having miscellaneous dental disorders. (f) Lipid-P tends to higher values in individuals having tooth abnormalities, thus simulating trend for cholesterol, although not to same extent. [Author's abstract].

Krasnow, Frances, Edith B. Oblatt, and Naomi Kaplan, 1936b. COLLECTION OF HUMAN SALIVA FOR QUANTITATIVE BIOCHEMICAL STUDIES. *Jour. dent. Res.*, 15 (5): 367-368.

The following conditions should be met: (A) Preparation of patient before collection-- (a) Definite physiological plane for at least one week preceding analysis, to preclude unusual or cyclic dento-medical symptoms, unless included in projected investigation. (b) Detailed record of diet for week preceding analysis. (c) Eight hours of sleep night before each test-day. (d) No brushing of teeth or rinsing of mouth, nor breakfast or smoking, on morning of test day. (e) Interval of 1.5 to 2 hours between rising and collection, to include 15-minute rest at laboratory. (B) Collection for analysis-- (f) Saliva for pH, CO₂, or other labile components: minimum volumes obtained by expectoration of

spontaneous flow. (g) For Ca, Mg, and similar positive ions-- and for PO₄ (recorded as P), and similar negative ions, protein, and lipids--total of approximately 40 cc. of spontaneous secretion collected with aid of suction and dental ejector. Mixed secretion obtained, and time taken to secure it recorded. Composition of samples (f-g) approximates very closely that of similar volume of mixed saliva in spontaneous flow. To obtain comparatively large samples from very young children, suction employed. Paraffin-stimulated post-absorptive saliva showed apparently same reliability in concentration and duplication for protein, Mg, and perhaps Ca, but yielded much lower P figures. Stimulated salivation is precluded in study of salivary composition in infants--field now receiving increasing attention. (Author's abstract)

Krasnow, Frances, 1936c. BIOCHEMICAL ANALYSIS OF SALIVA IN RELATION TO CARIES. *Dental Cosmos*, 78 (3): 301-310.

A summary is presented of representative data on salivary constituents obtained by various investigators, with particular reference to pH, calcium, and phosphorus. A relationship between variation in these components and dental caries is suggested.

Krasnow, Frances, and Yetta Porosowska, 1937. ADSORBENTS FOR CALCIUM AND PHOSPHATE PARTITION. *Jour. dent. Res.*, 16 (4): 346-347.

An attempt to corroborate the findings of various authors on differential partition of salivary Ca and PO₄ was unsuccessful, due to a lack of standardized adsorbent.

Krasnow, Frances, and Edith B. Oblatt, 1937a. SALIVARY CHOLESTEROL. *Jour. dent. Res.*, 16 (2): 151-155.

Analyses were made showing the distribution of cholesterol values of saliva in general and in association with dental caries and erosion. A method for quantitative determination is described, based on the technique of Myers and Wardell. Some determinations made in duplicate checked within 10%.

The cholesterol contents of the salivas of 71 persons, 17 paraffin-stimulated and 54 unstimulated, ranged from 2.3 to 50.0 mg./100 cc. For clinically normal individuals (those free of dental caries or erosion), the cholesterol values ranged from 2.3 to 9.4, averaging 7.9 ± 1.0 mg./100 cc. saliva; for erosion cases, the average was 13.7 ± 2.5 mg./100 cc.; and for caries cases, 11.8 ± 1.3 mg./100 cc.

A distinct tendency to increased cholesterol in saliva, particularly when acid, is apparent in the salivas of caries and erosion susceptible individuals. The cholesterol values of alkaline saliva from erosion and caries averaged 5.3 ± 2.1 and 9.2 ± 0.7 mg./100 cc., respectively; those in acid saliva averaged 15.7 ± 2.9 and 13.5 ± 2.0 mg./100 cc., respectively.

Krasnow, Frances, 1938. ROUTINE DIET AND SALIVARY ANALYSIS AT THE GUGGENHEIM DENTAL CLINIC. *Jour. Amer. dental Assoc.*, 25 (2): 216-222.

A program of dietary routine is presented which is aimed toward improving the dental health of the patient. One part of the program, concerned with the analysis of saliva, is based on the principle that variations in the chemical

picture of the saliva reflect changes in the general and dental health of the individual. The author lists certain conditions which are necessary in obtaining standardized salivary samples: (1) Absence of recent illness. (2) Thorough cleansing of mouth before retiring the evening preceding the test day. (3) No cleansing of mouth, no breakfast, and no smoking on the morning of the test. (5) A 1-1/2- to 2-hour interval between the time of rising and the time samples are collected. (6) A detailed record of the meals for a week preceding the analysis.

A procedure for analyzing the samples is presented as follows: After a 15-minute rest period at the laboratory, a sample of saliva (0.5 to 1.0 cc.) which is used for the hydrogen ion concentration determination is collected by spontaneous flow. A large sample (40 cc.) is then collected by the aid of suction and a saliva ejector. Aliquots of this sample are used for the determination of calcium, magnesium, inorganic phosphate, lipid phosphorus, cholesterol, and protein, according to methods previously published by the author.

Krasnow, Frances, 1939. SALIVARY ANALYSIS: A DIAGNOSTIC INDEX OF BIOCHEMICAL CHANGE IN THE ORGANISMS. Jour. Dental Res., 18 (3): 283-284.

"Increasing evidence is indicated that: (1) Different oral manifestations are apparently characterized by definite divergence from the average normal salivary composition, i.e. that of subjects within the age range of 5 to 20 years and in whom medico-dental clinical and laboratory examinations could discern no pathological involvement. (2) Similar variations are likely to be associated with such systemic conditions as cardiac malfunction, highly nervous states, infection occurring in individuals without dental disorders. (3) Variations from the normal average levels of the several salivary constituents is accentuated when systemic abnormality accompanies dental disorders. (4) A common mechanism is plausible in the tendency to that type of derangement often associated with acidic states in the body. (5) Dietary studies as a possible basis for the probable unbalance of positive and negative ions revealed a great preponderance of acid potentialities. (6) Among the lower income groups the acid:base ratio ranges from 5 to 1, the smaller obtaining only infrequently and not always in relation to economic status. (7) Nutritional regulation with quantitative control of the seven food types in addition to other physiologic needs of the individual has resulted in bringing aberrant salivary values within the normal range. (8) Furthermore, clinical evidence is accumulating which points to the decrease of susceptibility to caries and erosion under such a regime." (Author's abstract)

Krasnow, Frances, and E. B. Oblatt, 1940. SALIVARY MAGNESIUM. Jour. dent. Res., 19 (3): 305-306.

The results of salivary analyses of 191 cases, varying in age from 4 to 57 years, support results previously published. (Krasnow et al. Jour. Periodont., 9: 42, 1938).

Krasnow, Frances, and E. B. Oblatt, 1938a. SALIVARY PROTEIN. Jour. Dental Res., 17 (4): 329-330.

"Evaluation of data on 150 cases ranging in age from 5 to 50 years. Series includes individuals who are (1) without any malfunction as far as medicodental clinical and laboratory examination could discern, (2) caries free but have systemic involvement, (3) caries susceptible without or with other ailments not specifically dental in nature, (4) suffering from erosion (abrasion, wastings) without or with additional pathology. There is apparently a statistically significant elevation for groups (2), (3), and (4), when respective averages are compared with that of group (1). Odds against random occurrence of differences seem to increase as the care in selecting "normals" becomes more scrupulous. Also, analytical method developed for determination of total salivary protein is critically compared with other available procedures and shown to be accurately applicable." (Authors' abstract)

Krasnow, Frances, 1945. PHYSIOLOGICAL SIGNIFICANCE OF PHOSPHOLIPID IN HUMAN SALIVA. Jour. dental Res. 24 (6): 319-326.

Studies on 207 variously conditioned persons showed estimable amounts of phospholipid phosphorus to be present in human saliva, ranging from 0.04 to 1.00 mg/100 ml. (with only 2 exceptions). A detailed description of the method of analysis is given.

Tabulations, when graphed, approached the normal bell shape curve with a peak between 0.13 and 0.16 mg, with major skewness occurring beyond 0.40.

The salivary samples were divided into 2 groups—those obtained from persons adjudged normal clinically and those obtained from persons of deficient health. Low phosphorus values (for the most part below 0.13 mg./100 ml) were obtained from the normal individuals while 80 of the "abnormal" rose above this level. The means were 0.119 ± 0.011 and 0.246 ± 0.015 respectively.

The abnormal subjects were then subclassified and compared with the normal. Series II (individuals with systemic malfunctions) showed a lower number of individuals with low phosphorus levels (below 0.13 mg.) and an increased number of those with high phosphorus levels. Series IV (individuals with general indisposition as well as evidence of active tooth decay) showed an even further reduction in lower values and increase in higher ones. The peak and span for series III (individuals with tooth decay only) were in positions intermediate to corresponding points for the other two.

Phospholipid phosphorus contents were also tabulated for 4 additional subgroups: series V, individuals with dental erosion; series VI, with systemic troubles as well as dental erosion; series VII, a composite of III and IV, and series VIII, a combination of V and VII.

The arithmetic mean of each abnormal sub-group was higher than that of the normal. Significant ratios were obtained by statistical evaluation in all but series II, a class of few cases and of conditions closest to the normal.

Since tooth decay is characteristically encountered in childhood and early adulthood, and dental erosion from early adulthood into late life, the age factor was analyzed. It showed that phosphorus levels were higher in individuals over 20 years of age than in younger ones. The differences were, however, smaller than those effected by

disease. Again, persons with physiological malfunctions showed means above the average normal. Return to health was associated with a change in salivary alcohol-ether soluble phosphorus toward the normal, 0.119.

The author suggests the use of such analyses as a diagnostic aid in determining early deviation from health.

Krasnow, Frances, and Nina Budzinsky, 1950. PROTEIN IN BASIC AND ACIDIC HUMAN SALIVA. *Jour. dental Res.*, 29 (5): 693-694.

"Analyses of total postabsorptive saliva were made on 240 cases ranging in age from 3 to 66 years. Their physiological conditions varied: 30 had no tooth involvement (I); 137 suffered from caries (C); and 73 indicated erosion lesions (E). Each of these groups was subdivided into those without systemic malfunction (designated ns) and those who complained of some generalized ailment (designated s) giving 18 Ins and 12 Is, 98 Cns and 39 Cs, 59 Ens and 14 Es. These 6 series were further classified with regard to salivary pH. The normal (Ins), implying no discernible tooth or other disturbances and 94.5 per cent manifesting pH 7 or above present a protein mean content equal to 281 mg. per 100 ml. Compared with this, elevated concentrations were demonstrated by all other groups—the acid subdivisions being higher every time except for the one questionable caries-free, non-systemic individual. Obtaining pairs of figures will exemplify: Is-317, 334; Cns-330, 350; Cs-317, 400; Ens-327, 407; Es-386, 480. Moreover, the difference between the series for cases with systemic symptoms is greater than between those without any generalized illness as inspection of Cns and Cs or Ens and Es elicits. Values for D/S. E. mean, alkaline saliva caries or erosion groups minus mean, Ins equals 2.2 and 2.2, respectively, while D/S. E. mean, acid saliva caries or erosion series minus mean, Ins equals 4.7 and 5.0. Thus, aberrations in protein for salivas of pH 7 or above are probably real requiring additional case verification, whereas those for acid pH show absolute statistical significance." (Complete paper.)

Krasse, Bo, and B. Gustafsson, 1958. BUFFER EFFECT OF SALIVA STIMULATED BETWEEN AND AT MEALS. *Jour. Amer. dent. Assoc.*, 56 (1): 50-54.

Determinations were made of the amount of saliva and its buffer effect, in samples collected from each of 15 subjects during 5-minute periods, while chewing paraffin wax or chewing gum between two ordinary meals and immediately after a main meal. Determinations were also made of the amounts of total solids, calcium, phosphorus, and carbon dioxide in the paraffin-stimulated samples of saliva. Results show significantly higher mean buffer values (as m Eq HCl/L to pH 5.0) in salivary samples collected at meals (paraffin-activated, 22.6; gum-activated, 23.1) than in samples collected between meals (paraffin-activated, 16.9; gum-activated, 18.0); the amount of saliva stimulated during the 5-minute period by either wax or gum was slightly higher in samples collected at meals. The mean salivary volume % of carbon dioxide was significantly higher at meals (29.4) than between meals (20.8) while the mean mg% values of phosphorus in the same samples (respectively 10.2 and 13.1) were significantly lower at meals. No significant

salivary differences were found in percent of total solids or in calcium concentration.

Krasuskii, V. K., and M. K. Krymskaia, 1940. NEKOTORYE BIOLOGICHESKIE OSOBENNOSTI RABOTY OKOLOUSHNOI ZHELEZY U ZHVACHNYKH. SOOBSHCHENIE I [Some biological peculiarities of parotid function in ruminants]. *Fiziol. Zhur.*, 28 (4): 372-382.

Two peculiarities of the parotid glands in ruminants described earlier - their uninterrupted secretion and high alkalinity - and the fact that sheep perish from the fistulation of even one parotid gland (probably due to the absence of alkalis to neutralize the acidity of the paunch - Popov, 1932), induced the author to study the influence of organic and inorganic acids, alkalis, and alkaline and neutral salts on the function of the parotid glands in sheep, by stimulating either the oral mucosa or the paunch. Experiments were made in 4 sheep operated upon according to the Kudriavtsev and Anurov method. A cannula was inserted into the oesophagus. The stimuli were introduced in solutions in the amount of 25 cc. either orally or through the oesophagus fistula; moreover, in several experiments, 100 cc. solutions were introduced directly through a paunch fistula. The stimuli used were normal or decinormal solutions of acetic, lactic, isobutyric, tannic, hydrochloric or sulfuric acids, sodium hydroxide, potassium hydroxide, sodium carbonate, sodium bicarbonate, potassium carbonate, potassium bicarbonate, ammonium chlorate, ammonium sulfate, sodium chlorate, calcium chlorate, potassium chlorate, magnesium chlorate, sodium sulfate, potassium sulfate and magnesium sulfate. The saliva was collected every 5 min., its alkalinity determined as well as its specific weight, and the dry residue, organic matter and ash weighed. About 500 experiments were made (all before feeding) with uniform results.

1. After stimulation of the oral mucosa:

a) acetic, lactic, butyric, tannic, hydrochloric and sulfuric acids were found to be strong stimulants of parotid secretion;

b) carbonates and bicarbonates of sodium and potassium are comparatively weak stimulants as compared to the acids;

c) ammonium salts and caustic alkalis are stronger stimulants than the carbonates and bicarbonates; potassium hydroxide is stronger than sodium hydroxide;

d) chlorine salts of sodium, potassium, and calcium greatly increase the parotid secretion; sulfates of sodium and potassium increase the secretion but negligibly.

2. After introduction of the stimuli through the oesophageal fistula:

a) acids are found to have a slight stimulating effect on the parotid gland; the effect of carbonates and bicarbonates, ammonium and neutral salts as well as caustic alkalis is less defined: they may either slightly reduce or increase the glandular function or leave it unchanged.

3. After introduction of the stimuli directly into the paunch:

a) hydrochloric acid is found to increase the secretion of the parotid gland;

b) ammonium carbonate and sodium carbonate inhibit its function.

4. The alkalinity of the saliva after stimulation of the oral mucosa

a) is increased through the use of organic, but not always through inorganic acids;

b) through ammonium salts (with the exception of NH_4Cl) and through caustic alkalis it is somewhat diminished;

c) after bicarbonates it has a tendency to increase, after carbonates - to decrease, the fluctuations being, however, close to normal;

d) after chlorides and sulfates it remains within normal limits.

5. No deviations from normal have been noticed in the alkalinity of the saliva after introduction of acids, salts or alkalis into the pre-gaster through the oesophagus.

6. After direct stimulation of the paunch, the alkalinity of the saliva is increased after hydrochloric acid and sodium carbonate, decreased after ammonium carbonate.

7. The amount of ash is decreased after most of these stimuli. The percentage of organic matter in relation to the ash is always increased, except after stimulation by water or sulfuric acid.

8. The author concludes that the parotid glands of the sheep are undoubtedly the regulator of the acidity in the paunch. The mechanism of this process is apparently very complicated. According to the present findings, both the organic and mineral components of the saliva participate in the regulation of the salivary reaction. There is every reason to assume the existence of a reflectory connection between the paunch and the parotid glands.

Kraus, Frederick W., Diana W. Casey, and Vilma Johnson, 1951. AUREOMYCIN AND TERRAMYCIN IN HUMAN SALIVA. *Proc. Soc. exper. Biol. Med.*, 78 (2): 554-558.

The value of oral administration of antibiotics in the reduction of mouth organisms was evident when aureomycin and terramycin, ingested in capsule form, were excreted in saliva up to 24 hrs. after medication was discontinued. A reduction in salivary bacterial counts was effected by a 3 g. dose, apparently lasting for 24 hrs. The administration of the antibiotics in troches (15 mg.) effected a significant reduction in bacteria for 1 hour, but was obvious in the salivary secretion for only 3 hrs.

Kraus, Frederick W., 1951a. ANTIBIOTIC LEVELS IN HUMAN SALIVA. *Jour. dental Res.*, 30 (4): 495-496.

"Twenty dental students were each given 3 grams of aureomycin HCl in capsules. Five hundred milligrams were administered every 4 hours. Blood and unstimulated saliva were collected and assayed 2-1/2 hours after both the first and the final dose, and again 24 hours later. The respective mean plasma levels were: 0.63 mcg. per milliliter (Range 0.25-2.0); 4.3 (1.0-16.0); 0.11 (<0.063-0.25). The mean saliva levels were: 0.09 (<0.063-0.25); 0.45 (<0.25-2.0); 0.09 (<0.063-0.25). These results were checked by testing inhibition of test organisms (*B. cereus*) in plain saliva and plain serum (3 tests for each, negative) and for alteration of antibiotic activity in saliva or serum under routine assay conditions (2 tests each, negative). Since the experimental readings were clearly attributable to presence of antibiotic in saliva, its source was investigated by catheterizing parotid and submaxillary ducts of 4 medicated subjects. The pooled parotid salivas

and the pooled submaxillary salivas each contained detectable concentrations of aureomycin. Terramycin HCl similarly administered to 6 subjects was assayed in both plasma and saliva. One 15 mg. aureomycin troche was dissolved in the mouth of each of 6 subjects and, while the mean salivary concentration declined rapidly within the first 30 minutes, it was still, after 3 hours, equal to almost 100 times the highest mean salivary concentration of the systemically administered antibiotic. However, both the excreted and the dissolved antibiotic in saliva were comparable in their reduction of oral bacterial population (8 subjects)." (Complete paper.)

Kraus, Frederick W., V. Johnson, and D. W. Casey, 1952. SYNERGISTIC EFFECT OF SALIVA WITH AUREOMYCIN AND TERRAMYCIN. *ORAL SURG.*, 5 (7): 782-786.

The synergistic action of saliva with aureomycin and terramycin is demonstrated. One-half the dose of aureomycin and less than two-thirds the dose of terramycin in the presence of saliva produce the same effect as the full dose of either antibiotic in broth alone. Saliva alone produced no inhibitive effect on the test organism, *Bacillus cereus* var. *mycoides*. The synergistic substance in saliva is heat-labile; its activity is lost by heating for 10 min. at 98° C.

Kraus, Frederick W., and Vilma Johnson, 1952a. SYNERGISM BETWEEN SALIVA AND AUREOMYCIN OR TERRAMYCIN. *Jour. dental Res.*, 31 (4): 474.

"The susceptibility of *B. mycoides* to the bactericidal action of aureomycin and terramycin in broth is variable. Therefore, calculated values for the median bactericidal concentrations of the antibiotics were substituted for individual readings of tube dilution 'sensitivity' tests. The LD_{50} for aureomycin in broth amounts to $0.041 \pm 0.012 \mu\text{g/ml}$. With the addition of pooled whole saliva diluted 1:160, the LD_{50} is 0.02 ± 0.007 . Saliva alone is not inhibitory to *B. mycoides* under the conditions of the test. With terramycin the magnitude of synergism is similar, since the LD_{50} for the antibiotic in broth (0.090 ± 0.008) is halved by the addition of dilute saliva (0.044 ± 0.011). Synergism with either of these antibiotics is destroyed by preliminary heat treatment of saliva (10 minutes at 98° C), by sterilization with 1 per cent ethylene oxide, or by filtration through fritted glass. Parotid saliva does not exhibit synergism. However, the absence of synergism with sterile saliva is not sufficient proof of a microbial origin of the synergistic substance. Its presence in 25 individuals indicates that it may be a normal constituent of whole saliva." (Complete paper.)

Kraus, Frederick W., A. P. Walker, and K. F. Cook, 1955. PEROXIDE AS A FACTOR IN SALIVARY ECOLOGY. *Jour. Dental Res.*, 34 (5): 704-705.

Differentiation of salivary bacteria, producing or not producing peroxide, was made by addition of erythrocyte solution and benzidine to BHI agar medium. Results from an average of 21 estimations of the saliva from each of 8 individuals show the true mean percentage of peroxide-producing colonies to be 58.2 ± 3.25 . The individual mean percentages, highly characteristic for the individual saliva, were independent of the mean total colony counts. Bacterial peroxide was detected in saliva. (From author's abstract)

Kraus, F. W., W. I. Perry, and J. F. Nickerson, 1958. SALIVARY CATALASE AND PEROXIDASE VALUES IN NORMAL SUBJECTS AND IN PERSONS WITH PERIODONTAL DISEASE. *Oral Surg. Oral Med., Oral Pathol.*, 11 (1): 95-102.

A total of 224 determinations each were made of the salivary values of catalase and peroxidase in samples of paraffin-stimulated whole saliva from 8 subjects completely free of periodontal disease, and from 22 subjects with moderate to severe manifestations of periodontal disease. Salivary samples were collected from the normal subjects five times daily at 2-hour intervals, starting at 7 AM, on 5 or 6 different days; catalase was measured as mEq of perborate decomposed/ml. saliva and peroxidase as mg. purpurogallin formed/ml. saliva. Enzyme determinations were made once for each of the diseased subjects, using a salivary sample collected at 11 AM. Results showed all individual catalase values to be highest and peroxidase values lowest in the salivary samples collected on arising. Differences between the initial mean values and those obtained from samples collected at 9 AM were highly significant; variations thereafter during the day were not significant. Significant differences in catalase and peroxidase levels were found between individuals and between the normal and the diseased subjects who showed the higher enzyme values; sex differences in the enzyme values were not significant.

Kreis, Boris, 1938. KÉRATITES DU LAPIN ET VIRUS SALIVAIRES [Keratitis in the rabbit and salivary virus]. *Compt. rend. Soc. Biol. (Paris)*, 127: 109-111.

A description is given of keratitis in rabbits resulting from inoculation of the cornea of the animals with human saliva. Herpetic and non-herpetic lesions are distinguished.

Kreis, Boris, 1938a. PRESENCE DU VIRUS HERPETIQUE DANS LA SALIVE DE PARKINSONIENS POST-ENCEPHALITIQUES [The presence of the herpes virus in post-encephalitic Parkinsonians]. *Compt. rend. de la Soc. de Biol.*, 127 (2): 108-109.

No evidence of the herpes virus was found in the salivas of 41 healthy subjects, some of whom were in daily contact with herpes and Parkinson's disease.

Three of the salivas of 34 postencephalitic Parkinsonians contained the virus and, in one case, an encephalitogenic strain was isolated.

Kretovnikov, A. N., and V. D. Maznichenko, 1938. O SEKRETSII SLIUNNYKH ZHELEZ U CHELOVEKA V VYSOKOGORNOM KLIMATE [Salivary secretion in man at high altitudes]. *Fiziol. Zhur.* 25 (3): 330-331.

Tests were conducted in several men in which an acidulated candy (1% citric acid) was used as salivary stimulant and held in the mouth for 5 min. at varying altitudes. The amount of saliva collected averaged 1.14 cc. at sea level, 0.90 cc. at 900 m., 0.64 cc. in the first days at 3630 m., 0.60 cc. after one year, 0.80 cc. after 2 years and 0.82 after 3 years at this altitude.

Evidence has thus been obtained that a redistribution of water takes place in the organism as a result of low moisture content of the air, which leads to a decrease in quantity of salivary secretion. This diminution is more accentuated in

the first days of a high altitude sojourn and gradually improves after the first year to an average approaching the amount of secretion at an altitude of 900 m.

Kriazhev, V. I. A., 1935. PISHCHEVYE REFLEKSY "STADNOGO KHARAKTERA" [Food reflexes of the "gregarious type"]. *Fiziol. Zhur. SSSR*, 18 (4): 683-697.

Investigation was made in 20 dogs to determine whether the natural food reflex of the "gregarious type" is inherited similarly to the unconditioned reflex, or acquired by individual experience, the salivary reflex serving as indicator. Two dogs were placed in stands 0.5 m. apart, one being fed periodically with meat-rusk powder, while the other, having parotid fistulas, was observed. Conditioned sound stimulation was induced by means of metronome of varying frequency. All the movements of the animal were registered automatically.

A tense orientation reflex, observed on the first day of testing, was replaced thereafter by a rather abundant salivation (23 to 92 secretion units were noted in response to 2 minutes of visual stimulation) even if the eating animal was not a dog. The saliva stimulating factor appeared to be sight of the eating movements of the neighboring animal or man and not the sight of food, which was not always palatable to the dog. The rate of salivation was dependent on exterior and interior stimuli; a satiated dog showed little or no salivary response to the sight of an eating animal, in contrast to a hungry dog which showed a greater increase in secretion with increase in degree of hunger or to the sight of 2 or more animals eating. The salivation, general movement, and respiration responses, generally evoked in all onlooking animals to the sight of eating action as well as to each separate reflex movement of eating, is termed the natural food reflex "of gregarious type." The salivary movement and respiration responses appeared in all animals in response to conditioned sound stimulation. Both natural and conditioned food reflexes "of gregarious type" were sporadic in nature, with the conditioned responses being unstable, and subject to extinction. Natural food reflexes to sight and smell are considered to be conditioned reflexes acquired by the animal's individual experience while the gregarious type of natural food reflex appears to be an inherited reflex.

Kriazhev, V. I. A., 1941. SLIUNNYE REFLEKSY U OBEZ'YAN [Conditioned salivary reflexes in monkeys]. *Fiziol. Zhur.*, 30 (4): 490-495.

A special immobilizing stand was constructed in the author's laboratory for the study of salivary reflexes in the monkey, which permits the animal to feed himself, but does not enable it to tear off the funnel attached to its [parotid fistula].

A conditioned salivary reflex was worked out in a baboon to 120 taps/min. of the metronome. This classical method proved very appropriate. The conditioned salivary reflex is very labile, with great fluctuations in the amounts of saliva secreted during equal periods of time; it is easily inhibited, or even blocked by the animal's motor excitement. The conditioned motor reflexes appear much earlier than the secretory reflex and are more stable.

Krinitzin, D. I. A., E. T. Khrutskii, F. S. Pavlov, A. S. Elovskikh, S. E. Babin, E. T. Poleshchuk, 1937. DANNYE O NERVNO-GUMORAL'NOR REGULATSII SEKRETOROI FUNKTSII SLIUNNYKH I SYCHUZHNYKH ZHELEZ I MOTORNOI DEIATEL'NOSTI ZHELUDKA U TELIAT [Data on the neural-humoral regulation of the secretory function of the salivary and abomasum glands and the motor function of the stomach in calves]. VI. Vsesoiuz. S'ezd fiziol., Biokhim. i Farmakol. Sbornik Dokladov, Tbilisi, Oct. 12-18, 1937, p. 760-763.

Data are presented concerning secretory activity of the salivary and abomasum glands in the bovine calf. Unlike salivary flow in carnivores, the parotid gland in ruminants secretes saliva continuously; the submaxillary gland exhibits interrupted secretory activity. Conditioned salivary response, which can be established in the calf, depresses or stops parotid salivary secretion from the already activated gland. Extinction of the conditioned reflex is followed by return of secretion to its former level. Stimulation of the submaxillary gland during its resting state elicits saliva, or increases its flow if a slight secretion is already present. Interaction of the neural and humoral mechanisms which regulate glandular secretion are discussed in detail.

Krinitzin, D. I. A., 1940. MATERIALLY O NEPRERYVNYKH SEKRETSII OKOLOUSHNYKH ZHELEZ U ZHVACHNYKH [Materials on uninterrupted secretion of the parotid glands in ruminants]. Fiziol. Zhur., 28 (4): 384-388.

Parotid secretion was studied in young ruminants under conditions of severe experimentation. The parotid glands were cannulated and the standard amount of secretion determined during 30 minutes of uninterrupted salivation after the animals had been fed: it averaged 10.5 to 15 cc/5 min. The parotid nerve and branches of the facial and trigeminal were then resected. Observation of the parotid salivation during 20 to 60 minutes following the operation proved that uninterrupted secretion continues after denervation. The author concludes that the continuous parotid secretion in ruminants does not depend directly upon secretory innervation.

In a parallel series of experiments, resection of both trunks of the vagus nerve - the other nerves remaining intact - resulted in the cessation of rumination. Five days after the operation, parotid salivation was studied under severe experimentation. The secretion had almost stopped. Upon stimulation of the parotid nerve, a small secretion was obtained. The author concludes that starvation of the ruminants, resulting from the cessation of pregaster motor activity after bilateral resection of the vagosympathetic trunk at the neck, stops the spontaneous secretion, although the reactivity of the gland is maintained. The continuous secretion of the parotid glands in ruminants is evidently due to the steady passage of digestion products from the intestine into the blood.

Krinitzin, D. I. A., 1949. VLIYANIE KORKOVYKH IMPUL'SOV NA ZHELEZISTUIU KLETKU V USLOVIYAKH POKOIA I POSTOYANNOI DEIATEL'NOSTI [The influence of cortical impulses on the glandular cell under conditions of rest and continuous activity]. In: Problemy Sovet. Fiziol., Biokhim. i Farmakol., Moscow, 1949, 1: 562-563. Abst.: Sovet. med. refer. Obozrenie, Fiziol., 1952 (12): 68.

The influence of cortical impulses on the salivary gland during either inactivity or continued activity was studied in dogs and in calves having fistulated salivary glands and isolated ventricle (Pavlov's method). The influence of feeding and teasing on the salivary secretion curve was determined. Analysis of these curves lead the author to conclude that the glandular cells react differently to cortical or subcortical influences.

Kriuchkova, A. P., 1939. PTIALIN V SLIUNE SOBAKI KAK POKAZATEL'MENIAIUSHCHEGOSIA FUNKTSIONAL'NOGO SOSTOYANIYA SLIUNNYKH ZHELEZ V ONTOGENEZE [The ptyalin in canine saliva as an indicator of the changing functional condition in ontogeny]. Fiziol. Zhur. SSSR, 27 (3): 366-370.

A further study (Kriuchkova, 1938m) was made on the possible presence of ptyalin at one or the other stage of ontogeny in the dog. Thirty-six puppies, from 1 day to 4 months of age, were examined under ether and morphine-ether anesthesia; some adult dogs were used as controls. The saliva was collected from the cannulated submaxillary gland after faradic chordal and sympathetic stimulation. Trommer's test was used for the qualitative, and Hagedorn-Jensen's test for the quantitative determination of glucose. Samples (0.5 or 1 cc.) of chordal or sympathetic-chordal saliva were mixed with 2 cc. of a fresh 1% starch solution, and incubated at 37 or 38° C. for one hour.

Experiments in six adult dogs showed no ptyalin in the chordal saliva of three, whether or not there had been preliminary sympathetic stimulation. Traces of cuprous oxide precipitate were found in the saliva of the other three dogs; the amount of glucose in the saliva was insignificant (not over 1 mg./cc. saliva). The amylolytic action is greater in the first sample of chordal saliva than in the following, due to a greater dry residue content.

All experiments made in puppies in the first days of their life showed no trace of ptyalin in the saliva. In sixteen dogs up to 1.5 month of age, ptyalin could be detected, either in chordal or sympathetic-chordal saliva of only two dogs. A previous finding (1938m), that the sympathetic nerve does not act on the salivary glands of the dog younger than an average age of 30 to 40 days, was fully confirmed. After this age, the amount of organic substances in the samples of chordal saliva following preliminary sympathetic stimulation increases up to 3%.

In puppies over 1.5 month both sugar tests were positive. The amount of sugar varies from 2 to 5 mg./cc. saliva. After preliminary sympathetic stimulation, the ptyalin content in chordal saliva is greater than in chordal saliva which is unpreceded by sympathetic stimulation. Beginning with the 4th to 5th month, the ptyalin in saliva either disappears completely or remains in insignificant amounts.

The author suggests that the capacity of producing the enzyme appears under the influence of the beginning sympathetic function. Both, the sympathetic action and the appearance of ptyalin, coincide with the change of the puppies' diet from milk to mixed food. The increase of ptyalin in the saliva after sympathetic stimulation supports this conclusion. It is therefore assumed that the sympatheticus is a mechanism participating in the output of the specific products of secretion, i.e. it functions as a trophic adaptation mechanism.

Kriuchkova, A. P., 1940. ROL' SIMPATIKUSA V REGULIATSII FUNKTSIONAL'NOGO SOSTOIANIYA SLIUNNOI ZHELEZY V ONTOGENEZE [The role of the sympathetic nerve in the regulation of the functional condition of the salivary gland in ontogeny]. Fiziol. Zhur., 29 (1-2): 47-53.

Study was made of the sympathetic influence on the salivary gland in puppies 1.5 month old and over. Twenty-five puppies were starved for 24 hours, their tympanichord and sympathetic nerve exposed under morphine-ether anesthesia and the submaxillary gland cannulated; the vagus nerve was cut at the level of ganglion nodosum. Salivary stimulation was done through induction current of maximum intensity (Bernstein interruptor, frequency 30-40/sec.) applied to the exposed nerves. The following results were obtained:

In puppies aged up to 1.5 month, stimulation of the peripheral end of the sympathetic nerve results in a marked increase of organic substance in the saliva secreted in response to chordal stimulation. The intercalation of prolonged intervals between two successive stimulations of the chorda may produce a greater amount of organic matter in the subsequent portions of chordal saliva. These alterations are due to impulses coming from the sympathetic centers, for they disappear after excision of the upper cervical sympathetic ganglion. They only take place in dogs of 1.5 to 3 or 4 months of age.

The author concludes that the participation of sympathetic innervation in the control of the activity of the salivary glands is primarily concerned with the regulation of the qualitative aspect of the salivary reaction.

Kroll-Liefschütz, D. E. and N. V. Timofeev, 1935. OPYT IZUCHENIYA "SMESHANNOGO" VKUSA U ZHIVOTNYKH [Experimental study of "mixed" taste in animals]. Fiziol. Zhur. SSSR, 18 (1): 100-107.

The stimulatory effects of various dilutions of NaCl, HCl, glucose, and quinine hydrochloride were determined on parotid gland and gastric secretions in experimental animals. The oral cavity was irrigated for 30-second periods with test dilutions used alone or mixed; the salivary rate of flow was measured in cc./minute. Determinations of threshold concentrations showed that of NaCl to be 0.4-0.56M, and of HCl to be 0.024N; threshold concentrations of glucose (1M) and of quinine (N/1000) were less distinct than those of NaCl or HCl, and elicited a less-pronounced salivary response. Simultaneous irrigation with subliminal concentrations of NaCl and HCl showed the presence of a threshold combination of subliminal concentrations, eliciting 90 units of saliva whereas threshold concentrations of either substance alone stimulated 30 to 40 units; the salivary response to the combined irrigation was apparently due to a summation of the stimulatory effects of both NaCl and HCl. Mixtures of subliminal concentrations of NaCl, HCl, and glucose elicited no saliva; a combination of threshold concentrations of the three substances stimulated a weaker response than threshold concentrations of either NaCl or HCl used alone. Mixtures of subliminal concentrations including quinine were ineffective, whereas quinine used alone elicited considerable salivary flow, and increased the salivary response to combinations of quinine or glucose with NaCl and HCl if administered prior to irrigations with such combinations.

Kroll-Liefschütz, D. E. and N. V. Timofeev, 1935a. BIOLOGICHESKII METHOD OPREDELENIYA KONTSENTRATSII VESHCHESTV, VYZYVAIUSKCHIKY SOLENYI I KISLYI VKUSY. [Biological method of determining the concentration of substances eliciting salty or acid tastes]. Fiziol. Zhur. SSSR, 18 (1): 107-114.

A continuation of a previous study (Kroll-Liefschutz, 1935) is presented. Correlations were made between NaCl and HCl mixtures which did and did not elicit salivation; threshold-determinations were made of these stimulants in food-solutions of unknown concentrations. Meat extract was found to produce a taste reaction because it contained substances similar to both NaCl and HCl, whereas sorrel displayed only an HCl-like action. The salivary stimulation effects of concentrations of carrot and beet juices were also investigated. It was concluded that use of the methods employed permits determination of the taste-stimulation intensity of substances which have a NaCl- or HCl-like action.

Kroll-Liefschütz, D. E., 1935b. VLIYANIYE TEMPERATURY RASTVOROV NA VYSOTU PRORGOV RAZDRAZHENIYA VKUSA U SOBAKI [The influence of the temperature of solutions on taste stimulation in dogs]. Fiziol. Zhur. SSSR, 18 (1): 115-122.

The influence of solution temperature on parotid salivary response to a taste-stimulating solution, at the peak of threshold stimulation at room temperature, was studied in a fistulated dog. Solutions of NaCl, HCl, glucose, and quinine were administered at temperatures from 0° to 50°C. at 5° intervals. The threshold was lowered by salt or acid solutions at 0°C. and to a greater extent by such solutions at 38° to 43°C where the lag period was shorter and the secretion more abundant than that evoked by the solutions at room temperature; intermediate temperatures produced no change in salivary response. Variation in temperature of glucose or quinine likewise effected no apparent change in salivary response. Administration of distilled water elicited a small salivary response only at temperatures of 48° to 50° C.

Krylov, V. A., 1934. DVOIAKOE DEISTVIE ATROPINA NA SLIUNOOTDELENIE [Double action of atropine on salivary secretion]. Klin. Med., (Moskva) 12 (6): 867-868.

Study of the effects of atropine on salivary secretion in dogs having parotid and submaxillary fistulas showed the drug to initially produce an insignificant amount of salivation. Application of atropine to the oral mucosa elicited saliva by stimulating nerve endings unless preliminary anesthesia had been induced with cocaine. Injections of 1 cc. of 1:1,000,000 atropine sulfate into each of 15 dogs produced a 15-minute period of salivation in 11 of the dogs (10 drops from the submaxillary gland, 5 drops from the parotid in a 17 kg. dog); salivation could be elicited in 9 of the dogs with a dose increased to 1:300,000. A conditioned salivary response to atropine, established in 65% of dogs tested by subcutaneous injection of 0.5 mg. of atropine daily for 9 days, started with abundant salivation before cessation of secretion. The conditioned salivary response as well as typical atropine effects followed injection of physiological solution in place of the atropine.

Kung, Jo-fen T., Virginia M. Hanrahan, and M. L. Caldwell, 1953. A COMPARISON OF THE ACTION OF SEVERAL ALPHA AMYLASES UPON A LINEAR FRACTION FROM CORN STARCH. Jour. Amer. chem. Soc., 75 (22): 5548-5554.

Swine pancreatic, crystalline bacterial, human salivary, human pancreatic, and swine salivary amylases, recrystallized taka amylase, subtilis, and fat-free extracts of homogenates of rat pancreas, liver, spleen, and blood serum were studied, and their rates of hydrolysis of a linear substrate (starch) were noted. Generally, the reducing values of the hydrolyzate were found to be independent of a given amylase concentration, and graphed results showed that the value peaks, obtained from absorption spectroscopy measurements, shifted toward the shorter wavelengths as the hydrolytic process continued.

More specifically, human salivary amylase from the same person or from different persons hydrolyzed the starch substrate in the same manner as human pancreatic amylase during the initial stages of the reaction; although the concentrations of amylase were different during various times of the day, and in different individuals, the action of the salivary amylase was uniform (the action of human pancreatic amylase was the same as that of the salivary amylase).

Amylase preparations secured from various organs of the rat were similar in action to human salivary and pancreatic amylases. Swine pancreatic amylase, on the other hand, differed in its hydrolytic action from swine salivary amylase, and both differed from human pancreatic and salivary amylases.

It is concluded that the different alpha amylases tested differ in their initial reactions on a linear fraction of corn starch. All of the amylases investigated have an important characteristic in common: all produce the rapid hydrolysis of a linear fraction of corn starch into materials which do not form color compounds with iodine, and which usually consist of 7 - 13 glucose residues.

Kupalov, P. S., and M. A. Smirnit'skaia, 1923. O VLIĖANII SODY NA SEKRETORNUIU DEIATEL'NOST' PODCHELIUSTNOI SLIUNNOI ZHELEZY [On the influence of sodium on the secretory function of the submaxillary gland]. Vrachebnoe Delo, Kharkov, 6 (24-26): 678-682.

The influence of sodium on the salivary gland was studied in cats, based on Langley and Fletcher's data (1889). Tracheotomy was performed under chloroform and ether anesthesia; the submaxillary duct was exposed and cannulated, the amount and rapidity of secretion registered every 30 seconds. If necessary, the lingual nerve was resected and ligated above the place where the chorda tympani and the sympathetic diverge. Sodium carbonate (10 cc. at 7.5 to 10%) or bicarbonate (0.5 to 1.5 cc., or 6 cc. at 1%) were injected into the femoral vein through a cannula. The chorda tympani or sympathetic nerve were stimulated by the usual induction coil from one accumulator during 30 sec. or 1 minute (reel distance, 11 to 14).

After injection of 10 cc. of 10% Na₂CO₃, a decrease in chordal secretion is first observed; after subsequent stimulation of the chorda during 1 minute, a secretion increase follows which lasts from 3 to 12 minutes, the total secretory

effect being nearly double in extent; after the third chordal stimulation, the secretion is decreased about 25%, and the duration of secretion drops to 1.5 minutes. After several repeated injections of sodium, the secretion flow drops abruptly and stops. This fact is believed to be due to the large dose of sodium which, after stimulating the gland, leads to its paralysis. A number of experiments confirmed the correctness of this assumption, which also corroborates Langley and Fletcher's data.

In a series of experiments, the chorda tympani and the lingual nerve were resected on one side. After sodium injection (7 cc. of 10% Na₂CO₃), it was observed that the gland with intact innervation secreted about five times more saliva and during a longer period of time than the denervated gland. It can be said that sodium acts on the salivary glands both locally and through the salivary center. However, it was seen in many experiments that the gland with resected nerves did not respond to the injection of sodium and started to secrete only after nerve stimulation.

Large doses of sodium create a prolonged after-effect; they often elicit salivation without nerve stimulation. After injection of small amounts of sodium (1.0 - 2.0 cc. 10%), the chordal stimulation produces a greater effect than normally. Apparently, even small doses of sodium act on the gland, but nervous stimulation has to be added to elicit secretion. In the same manner, if after a chordal stimulation too small to elicit secretion, a sodium injection is added, prolonged secretion will follow. Laboratory findings showed that after chordal stimulation the salivary gland remains in a stimulated condition during 10 to 12 minutes. After sympathetic stimulation the sodium after-effect is only 2 to 3 minutes.

Thus the mechanism of the secretory sodium after-effect seems to depend on two factors: the stimulating action of sodium on salivary secretion, and the latent stimulation of the nerve.

Kupalov, P. S., 1925. PERIODICHESKIE KOLEBANIĖ SKOROSTI USLOVNOGO SLIUNOOTDELENIĖ [Periodic variations in the rate of conditioned salivary secretion]. Arkh. biol. Nauk, Leningrad, 25 (4-5): 167-174.

Two types of conditioned salivary response occur, one characterized by a gradually increased salivation rate and the other by a periodically varying secretion rate. Central cerebral changes producing the periodic variation in flow rate are discussed.

Kupalov, P. S., 1933. UGASHENIE USLOVNOGO REFLEKSA PRI DLINNOM I KOROTKOM PRIMENENII USLOVNOGO RAZDRAZHITELĖ [Extinction of the conditioned reflex after long or short conditioned stimulation]. Arkh. biol. Nauk, Leningrad, 33 (5-6): 679-688.

Extinction of a conditioned salivary reflex, to a weak light stimulus by means of brief or long visual stimulations with weak light, was studied in a dog having strong positive reflexes. Results show that extinction of the salivary response can be effected very rapidly and equally well by use of either brief or long visual stimulations.

Kupalov, P. S., and G. V. Skipin, 1934. SEKRETSIĖ PODCHELIUSTNOI SLIUNNOI ZHELEZY PRI RAZLICHNYKH RAZDRAZHENIIĖKH TSEREBRAL'NOGO NERVA

INDUKTSIONNYM TOKOM [The secretion of the submaxillary gland during various stimulations of the cerebral nerve by faradic current]. *Fiziol. Zhur. SSSR*, 17 (3): 464-472.

The rapidity of submaxillary secretion was studied in dogs under severe experimentation. To immobilize the dog, either chlorazol was injected intraveinously, the animal was decerebrated, or its medulla resected. The chorda tympani was exposed and immersed in silver electrodes of the Ludwig type. The sixth lingual nerve, and the vagosympathetic on the corresponding side of the neck were resected. The wound was then closed. Faradic stimulation was applied by Zimmermann's (5000 windings) induction coil from a 2-volt accumulator; short faradic stimulations were administered by Lucas' interruptor, modified by Parkinson; for single faradic strokes Bovdich's interrupter was applied. The submaxillary duct was cannulated and the saliva collected into tubes, graded from 0.00125 cc. to 0.01 cc. attached on a scale. Registration of the drops was made by a kymograph to which a electro-magnetic marker and timer were attached, marking the seconds and fifths of a second. The marker's chain could be rapidly shut or opened by a telegraphic type of key, which drew a mark on the paper. The observer followed the flow of saliva on the scale and marked each section, or every two or five sections, by means of the key. The intervals between the different marks were counted up to one tenth of a second and the curve of secretion drawn. This method gives very accurate results.

In studies using short faradic stimulations, stimuli of 0.05 to 1.0 sec. were applied with the minimal power necessary to obtain a distinct secretion. The distance of the secondary coil from the primary varied from 23 to 14 cm. The nerve placed on the electrodes was covered with cotton dipped in physiological solution, which reduced the effect of the distance between the two coils to a merely relative criterion of the stimulating strength of the current.

The results obtained were perfectly uniform. The secretion elicited by a short faradic current starts several seconds after the stimulation and lasts one minute, or one minute and a fraction, slowing down gradually. However, a secretion lasting as long as 2 minutes indicates the possibility that the gland may have responded by spontaneous secretion more than by stimulation.

After a stimulation lasting one or more seconds, the secretion curve presents a straight ascending line for about 5 seconds before decreasing. No data are given, as these results correspond exactly to those obtained by Heidenhain (1868) and Babkin (1927).

In studies using repeated short faradic stimuli, 0.1-0.2 second stimulations, repeated every 4 to 5 or 8 to 9 seconds, were found to elicit a continuous secretion with abrupt, wave-like rapidity changes. The accelerations and decelerations of secretion correspond exactly to the duration of stimulation; however, the range of these rapidity changes is not the same within one cycle. Each new stimulation first elicits rather regularly increasing waves of secretion; then after the secretion has reached a constant rate, one, 2, or 4 periods of sudden acceleration often set in, or more rarely, periods of deceleration. The start of accelerated secretion is often very abrupt and proceeds in such a manner

as to indicate a changing stimulation in the gland. The possible causes of this irregularity in acceleration are further discussed.

Use was also made of breaking faradic stimulation. This method differs from the usual stimulation, by induction coil and mechanic interruptor in a primary chain, only in the use of various rhythmical, including very slow, stimulations. The slow rhythm makes prolonged stimulation possible without disturbing the vital characteristics of the nerve.

During breaking faradic stimulation there is an initial period of rapid acceleration of secretion for about 1 minute, then the secretion may remain constant for a short while, after which follows a long period of gradual decrease in secretion. With slower rhythms, the decrease in rate of secretion proceeds slower.

If, at the moment when a practically constant secretion rate is reached, the shock frequency is accelerated during one or two seconds before reverting to its former value, a short increase in rate of secretion results. The curve obtained resembles closely the irregular salivation curve observed in conditioned reflex experiments. A frequency increase during 1 to 2 seconds, with continuous stimulation at regular intervals, practically amount to using additional faradic strokes following each other in rapid succession. This corresponds fully to the experiments with short faradic stimulation, with the difference that this stimulation is applied to an active gland, secreting at a rather constant rate. The secretion acceleration in response to additional faradic strokes proceeds with great regularity; it results in a regular summation of the secretion elicited by additional stimulation and the constant secretion. The curve obtained shows a steep ascent of secretion rate, followed by a regular decrease which corresponds exactly to the rapidity curves in short faradic stimulation.

Physiological mechanisms of these results are discussed.

Kupalov, P. S., and N. N. Pavlov, 1935. DEĬSTVIE KOROTKOGO USLOVNOGO RAZDRAZHENIĬA PRI ZAPAZDYVAĬUSHCHEM USLOVNOM REFLEKSE [The action of brief stimulation during the retarded conditioned reflex]. *Fiziol. Zhur. SSSR*, 18 (5): 737-738.

The effect of brief application of a conditioned stimulus (a musical tone) on a retarded conditioned salivary response was investigated in a dog. The retarded response to the 2-minute application of the tone before a feeding was characterized by a prolonged lag period before salivary response; salivation during the second minute exceeded that of the first minute of flow. Application of the tone during the first 10 seconds of the 2-minute stimulus period before food reinforcement, produced no conditioned response whereas application of sound during the first minute of the stimulus period evoked a salivary response similar to that of the 2-minute stimulus.

Kupalov, P. S., 1947. O DEĬATEĬ'NOSTI KORKOVYKH TSENTROV PO DANNYM ANALIZA KRIVYKH USLOVNYKH SEKRETSII [On the function of the cortical center according to the data of analyses of conditioned secretion curves]. *Fiziol. Zhur. SSSR*, 33 (4): 495-500.

Secretion curves of conditioned salivation show a resemblance to salivation curves obtained

under severe experimental conditions using faradic stimulation of the chorda. Inferences concerning the function of the cortical centers are made possible on the basis of analysis of the curves of the rate of conditioned salivation.

Kupalov, P. S., 1954. K METODIKE REGISTRATSII SLIŪNOTDELENIĖ [On the method of registration of salivary secretion]. Trudy fixiol. Lab., I.P. Pavlova, 3: 269-271.

The author's improved apparatus for registration of salivary secretion in conditioned reflex experimentation is described.

Kürt, Leopold, 1901. UEBER EIN NATÜRLICHES SCHUTZMITTEL BEI ANGINA DIPHtheritica UND ANGINA SCARLATINOSA (EINE NEUSE HEILMETHODE) [On a natural protective agent against angina diphtheritica and angina scarlatina (A new therapeutic method)]. Wiener med. Wochenschr., 51 (44): 2054-2058.

A natural defense mechanism in saliva against angina diphtheritica and a. scarlatina is indicated in the history of several cases in which sugar-stimulated salivary flow either healed or localized the disease, depending on the stage of infection when treated.

Kurtsin, I., 1938. VLIĖANIE AFFERENTNYKH IMPULSOV PISHCHEVARITEL'NOGO TRAKTA NA TECHENIE KORKOVYKH PROTSESOV [The influence of afferent impulses from the digestive tract on the course of cortical processes]. Fiziol. Zhur. SSSR, 25 (6): 885-904.

The interoceptive influences from the digestive tract on the conditioned reflex activity of the cortical centers was studied in dogs having gastric and parotid fistulas, using positive and negative conditioned salivary reflexes as indicators.

Kurtsin, I. T., and Gulĭaeva, L. N., 1953. INTEROTSEPTIVNYE VLIĖANIĖ S ZHELUDKA NA DEĖATEĻ'NOST' SLIŪNNYKH ZHELEZ U CHELOVEKA PRI ĖAZVENNOI BOLEZNI [Interoceptive influences from the stomach on the activity of the salivary glands in man, in ulcer cases]. In: Voprosy Fiziol. i Morfol. tsentral'. nerv. Sistemy, Moscow, 1953, p. 116-121. Sovet. med. refer Obozrenie, 1954 (19): 78-99.

The interoceptive influences on salivary gland activity were studied in 28 people, 3 of whom had a gastric ulcer and 17 a duodenal ulcer. Parotid saliva was collected from the capped duct and the amount of saliva measured in drops/5 min. Stimulation of the gastric mucosa was made by a probe (Kurtsin and Slupskii method) or by administration of 300 mg. of 5% alcohol. Stimulation of the mechanical or chemical gastric receptors elicited a strong salivary secretion, most pronounced after mechanical stimulation. In ulcer patients this reflex was either completely absent or insignificant. Shortly after an ulcer operation a certain increase in the gastric reflex on the salivary gland occurred and the normal salivary reaction was restored. The salivary glands relapsed into the previous state at remote dates after the operation, in case of deterioration of the patient's general condition. When abundant salivary secretion was elicited by gastric stimulation, acid gastric juice was also abundantly secreted and vice-versa. Mechanical gastric stimulation elicited abundant salivation and an

insignificant gastric secretion in operated patients, whose gastric juice lacked acidity.

Kutsin, A. M., G. P. Nikolaevskii, B. O. Lesin, 1950. O SODERZHANII SPETSIFICHESKIKH POLISAKHARIDOV V SLIŪNE CHELOVEKA V NORME I PRI ZABOLEVANIĖKH VIRUSNYM GRIPPOM [On the content of specific polysaccharides in human saliva under normal conditions and during virus influenza]. Doklady Akad. Nauk SSSR, 73 (4): 767-770. Abst.: Sovet. med. ref. Obozrenie, Fiziol., 1952 (10): 25.

The content of specific polysaccharides in human saliva was studied to determine the physiological importance of their presence in healthy subjects and in virus-influenza patients. Results showed a complete or almost complete disappearance of the specific polysaccharides in the patients' saliva. The normal content was restored after recovery. Tests in mice showed that the influenza virus sharply lowers the titer of the specific salivary polysaccharides. The assumption is made that the easy interaction of the salivary polysaccharides and influenza virus indicates a possible role of the specific polysaccharides of saliva and nasal mucosa in the defense of the organism against the influenza virus. The simple method of determination of these specific polysaccharides in the saliva is suggested as a means of diagnosis of the influenza virus.

Kutscher, Austin H. and N. W. Chilton, 1953. OBSERVATIONS ON THE CLINICAL USE OF A CHLOROPHYLL DENTIFRICE. Jour. Amer. dent. Assoc., 46 (4): 420-422.

The salivary lactobacillus counts of 20 patients aged 5 to 64 were determined before and after six to nine months use of a chlorophyll dentifrice. Results showed no significant difference in the lactobacillus counts.

The effect of the use of a chlorophyll dentifrice on chronic gingivitis was studied in 109 patients aged 11 to 65. Gingival appearance and sensitivity remained essentially similar to a control group of 137 gingivitis patients using a dentifrice of their own choice.

Kutscher, Austin H., N. W. Chilton, and J. Budowsky, 1953a. OBSERVATIONS ON THE CLINICAL USE OF TERRAMYCIN TROCHES. Oral Surg., 6 (5): 640-644.

A report is given of the effect of local oral terramycin therapy on gingivitis, periocoronitis, recurrent aphthous stomatitis, and on the salivary lactobacilli counts. Improvement was noted in 21 of the 50 patients treated for chronic gingivitis; in all cases there was a recurrence within 2 months. The therapy did not prevent a return of lesions or increase the length of free periods in aphthous stomatitis but the severity of the lesions was decreased during treatment. Symptoms were alleviated in 9 out of 10 cases of periocoronitis; 2 cases showed a recurrence within 2 months. There was no immediate or delayed effect on the lactobacillus counts of the saliva.

Kuz'menko, G. N., 1940. O CHEREDOVANII V RABOTE PODCHEĻIŪSTNYKH SLIŪNNYKH ZHELEZ SOBĖKI [On alternation in the function of the submaxillary glands in the dog]. Biull. eksper. Biol. Med., Moskva, 10 (6): 457-459.

Salivary flow, induced by subcutaneous injection of 2.5 mg. of pilocarpine, was measured in 2 dogs having bilateral submaxillary and single parotid fistulas. Parotid salivation was found to begin 15 to 20 seconds before submaxillary. Bilateral submaxillary flow was unequal, flow from one side greatly exceeding flow from the opposite for 4 to 16 minutes before reversal. The bilateral alternation in gland activity had no relation to mastication as secretion was pilocarpine-stimulated. Test results are tabulated and discussed.

Kyle, D. Braden, 1902. THE CHEMIC PATHOLOGY OF THE SALIVA AND PHARYNGEAL SECRETIONS (SIALO-SEMEIOLOGY) AS A MEANS OF DIAGNOSIS. *Amer. Med.*, 4 (2): 57-60.

A general discussion, with no experimental data, on the value of the chemical properties of saliva (specifically odor, color, consistency) as an index of pathological conditions, is presented. Several papers on the subject are reviewed.

Kyle, D. Braden, 1907. CHEMISTRY OF SALIVA IN RELATION TO HAY FEVER. *Jour. Amer. med. Assoc.*, 49 (5): 402-405; discussion, p. 405-406.

Qualitative chemical analyses of the salivas of persons having hay fever indicated that in 60% of the individuals, local irritation is primarily due to altered chemistry and resistance, and that these 60% may be divided as follows:

(1) Those individuals in which oral secretions are non-irritating, but undergo chemical changes to either acid, alkaline, or neutral, and produce irritation; (2) those in which secretions, as produced, are irritating without undergoing any chemical changes; and (3) those individuals whose secretions produce irritants by undergoing chemical changes on contact with certain extraneous materials, thereby giving rise to ragweed fever, rose cold, etc.

Individuals having any form of nasal obstruction or lowered vitality will react much more strongly than others; although the author does not claim the foregoing to be the explanation in all cases of hay fever, he claims that 60% of the cases can be explained on this basis.

Ladell, W. S. S., 1947. CREATININE LOSSES IN THE SWEAT DURING WORK IN HOT HUMID ENVIRONMENTS. *Jour. Physiol.*, 106 (3): 237-244.

Measurements were made in 4 male subjects of the creatinine content of saliva, blood plasma, and of serial samples of sweat after 160 min. exposure in an air-conditioned chamber (100°F; relative humidity, 77%; air movement below 50 ft./min.) while performing exercise at a mean metabolic rate of 120 kg. cal./hr. for the full test. A single salivary sample was collected from each individual during each test. The salivary creatinine content of one subject during 1 test was 0.318 mg./100 cc.; the mean of 3 samples of another was 0.276 mg./100 cc. The mean creatinine concentration in 7 such samples from the remaining two subjects was 0.455 mg./100 cc.; in 7 similar tests, after these two subjects had ingested 5 gm. of creatinine, the mean was 1.379 mg./100 cc. The highly significant mean difference is attributed to the higher creatinine content of the blood. A comparison of test results showed the normal creatinine content of the saliva to be lower than that of the sweat; after taking creatinine the salivary content

exceeded that of the sweat. A rise in the creatinine content of the blood produced a corresponding rise of salivary creatinine, but had little effect on that of the sweat.

Lafarga, J. V., 1922. LA RÉACTION DE LA SALIVE ET SON INFLUENCE POSSIBLE SUR LES CARIES DENTAIRES [The reaction of saliva and its possible influence on dental caries]. *Compt. rend. de la Soc. de Biol. (Paris)*, 86 (7): 412-414.

Experiments on human saliva included measurement of amount, pH, and buffer power. Mixed saliva tended to vary between pH 6.4 and 7.4 according to time of day or stimulus applied. In general the greater the abundance of stimulated saliva, the more alkaline and the greater is the buffering power. Acids (lemon, orange, vinegar, acetic acid) produced a greater increase in quantity, pH, and buffer power of saliva than alkaline substances (bicarbonate of soda, soap). Substances of indifferent taste caused little change in the three factors, while highly flavored substances such as quinine increased the quantity of saliva, but not its pH nor buffering power.

Experiments to determine the influence of pH upon decalcification of teeth showed that decalcification increased with increased acidity (below pH 7). Decalcification did not occur above pH 7. Ordinarily, therefore, saliva produces no or very slight decalcification, but fermentation of food in saliva in a limited space may produce a high acidity.

Saliva, varying about the neutral point and possessing a marked buffering power, is probably not an important factor in the development of caries but acts to protect the teeth.

Lammers, Theo, 1952. DAS ANTIBAKTERIELLE PRINZIP DER MUNDSCHEIMHAUT. (EIN BEITRAG ZUR FRAGE DER KLINISCHEN BEDEUTUNG EINER SCHLEIMHAUT-FLORA) [The antibacterial principle of the mouth mucosa: a contribution to the question of the clinical significance of a mucous-membrane flora]. *Zeitschr. f. Hyg. u. Infektionskrankh.*, 135 (3/4): 365-387.

Extensive experimentation on the antibacterial factors of saliva and of the oral mucosa led the author to conclude the following: A biological balance exists and is constant in the oral cavity of each individual, but varies from person to person. In three test persons, the numbers of streptococci and of "acidophilus bacteria" were quite constant over a 5 to 7 week observation period. In the first person (a 9-year-old girl), the acidophilus count was the same (0.25 million/cc. saliva) at the beginning and end of the test period, while the streptococcal count was 62 million at the start and 70 million after 7 weeks. In the second person, the values for acidophilus bacteria were 7.2 and 5.0 million organisms, respectively, (streptococci, 568 and 401 million) at the start and end of a five-week test period. In the third individual, respective values were 0.08 and 0.11 million acidophilus bacteria and 121 and 170 million streptococci. This balance is based on the "growth rhythm" of the oral bacteria and reflects the antibacterial principle of the oral flora.

The humoral antibacterial substances of saliva known as inhibines are metabolic products of the viridans type of streptococci and acidophilus bacteria; the only salivary humoral substances capable of influencing the bacterial flora are

alkali linkages, which inhibit the growth of acidophilus bacteria and shift the dominant relationship of the oral flora to the proteolytic groups. The reaction of the nutrient has a significant effect on the antagonistic potential of the microbes.

In vitro studies which showed the flora of the oral mucosa to possess antibacterial properties are of no significance, because the antagonistic potential of bacteria depends on their growth rhythm and not on the intensity of the antibiotic action of their metabolic products in vitro. 53 refs.

Lande, Antoni, 1939. SUR LES PROPRIÉTÉS BACTÉRICIDES DE LA SALIVA HUMAINE ET SUR LEUR VALEUR IMMUNOBIOLOGIQUE [On the bacterial properties of human saliva and their immunobiological value]. Medycyna doświadczalna i społeczna. Warszawa, 24 (1-2): 97-124.

Experiments confirm observations of Dold and his collaborators (1934, 1936) regarding thermolabile bactericidal substances in saliva. The substances pass through a Chamberland filter; thus it is impossible to separate them from other salivary elements. The salivary residue is the most active part, and thick sympathetic saliva has a much stronger bactericidal action than parasympathetic. The presence of mutes was also noted in one case, changing the diphtheric bacteria into pseudodiphtheric.

The titer of inhibines reaches 1:40 to 1:80. Sometimes a zone of inhibition is found. The saccharomycetes which are present in saliva were found to inhibit the growth of Bact. diphtheriae [Corynebacterium diphtheriae].

The author examined the saliva of 152 subjects to determine the immunobiological value of inhibines. In 26.3% of the cases human saliva possessed bactericidal action; in half of these, this action is referable to the antagonism of the saccharomycetes, in the other, to the presence of actual inhibines. The inhibines originating from saccharomycetes were observed mostly in individuals with neglected teeth. The true inhibines appear more often in individuals who have been healthy since childhood, than in those whose anamnesis shows diphtheria, scarlet fever, or angina. They appear three times as often in subjects with diseased tonsils. In carriers of the diphtheric bacterium they are very rare.

The bactericidal properties of saliva are not related to the blood groups, to the presence of blood group elements in the saliva, or to the sex or age of the subjects examined. (From author's abstract)

Landsberg, M., 1923. ÜBER DEN HARNSTOFFGEGHALT IM SPEICHEL [On the urea content in the saliva]. Klin. Wochenschr., 2 (7): 306.

The urea concentration of saliva, like that of sweat and of tears, is usually identical to that of blood. A case of uremia is described in which salivary urea concentration was examined. Results of the examination are not submitted.

Landsberg, Marcell, 1923a. RECHERCHES SUR LA CONCENTRATION DE L'URÉE DANS LA SALIVE [Research on the concentration of urea in saliva]. Compt. rend. de la Soc. de Biol. (Paris), 89 (37): 1343-1344.

A technique is given for determining the concentration of urea in human saliva which has been shown to be equal or nearly so to the amount of urea in the serum of persons suffering from azotemia.

Landsberg, Marcell, 1924. UNE NOUVELLE ÉPREUVE CLINIQUE DE L'AZOTÉMIE [A new clinical test of azotemia]. Compt. rend. de la Soc. de Biol. (Paris), 91 (36): 1345.

The saliva of a patient, collected after a thorough rinsing of the mouth, can be tested for urea with a solution of paradimethylamino-benzaldehyde in HCl. In azotemia, the addition of 2-3 drops of the solution to the saliva produces a green color.

Landsteiner, K., 1932. NOTE ON THE GROUP SPECIFIC SUBSTANCE OF HORSE SALIVA. Science (New York), n.s. 76 (1972): 351-352, Oct. 14, 1932.

Horse saliva contains a component which reacts with immune sera specific for the human blood group substance A (cf. Schiff et al., 1924). Treatment of horse saliva with acid and acetone and fractionation with alcohol resulted in an active preparation, which gave a weak biuret reaction, and upon hydrolysis yielded 48.5% reducing sugar (calculated as glucose).

Another preparation made in a different way from saliva adsorbed with kaolin and charcoal, reacted strongly with anti A immune sera and had the composition: C, 44.65%; H, 6.76%; N, 7.43%, and ash, 3.37%.

The author concludes that the data indicate that the group-specific substance A owes its peculiarity to carbohydrate groupings.

Landsteiner, K., and M. W. Chase, 1935. DECOMPOSITION OF THE GROUP A SUBSTANCE IN HORSE SALIVA BY A MYXOBACTERIUM. Proc. Soc. exper. Biol. Med., 32 (5): 713-714.

Experiments showed that Myxococcus—an organism known to attack carbohydrates—is capable of destroying the Group A substance in horse saliva in 2 to 7 days (after 7 days, only 2-10% of the original activity remained). The cultural properties of the bacterium are presented. The results are offered as evidence of the carbohydrate nature of the substance. Further work using Group A substance of man is warranted.

Landsteiner, K., and M. W. Chase, 1935a. ADDITIONAL NOTE ON DECOMPOSITION OF THE GROUP A SUBSTANCE. Proc. Soc. exper. Biol. Med., 32 (7): 1208.

In continuation of previous work (cf. Landsteiner, 1935m), the susceptibility of Group A substance of horse and human saliva to an organism known to attack carbohydrate—Saccharobacterium ovale—was studied. Its effects on A substance in commercial pepsin indicated the organism to be more active than Myxobacterium.

Landsteiner, K., 1936. ON THE GROUP SPECIFIC A SUBSTANCE IN HORSE SALIVA. II. Jour. exper. Med., 73 (2): 185-190.

The author studied a substance contained in horse saliva that reacts with group-specific immune sera produced by the injection of human blood of group A. (cf. Landsteiner, 1932m).

Saliva was obtained from a horse salivated by injection of 100 mg. of arecoline hydrobromide in

4 portions at intervals of 20 min. The method of separation and chemical analysis of the substance is described fully. The activity of the substance was tested by means of immune sera hemolytic for sheep blood, prepared by injection into rabbits of human blood cells of group A. Determinations of the inhibitory effect of the substance on the isoagglutination of A blood were made. 1/1000 of the substance could be detected by this method.

The substance was analyzed as follows: C, 44.56%; H, 6.91%; N, 7.08%; total S, 1.78%; sulfate S, 0.05%; P, 0.23%; acetyl (2 determinations), 9.40 and 9.47%; ash, 1.20%; reducing sugar after acid hydrolysis, calculated as glucose (3 det.), 56.2, 57.6, 58.2%.

From the data presented it is seen that in the chemical composition and properties, the horse salivary preparation is essentially carbohydrate in nature and is very similar to the preparations separated by Freudenberg from human urine. The substance gives negative reactions with almost all protein reagents, yields on hydrolysis a high percentage of reducing sugar, contains about 10% acetyl, and gives positive reactions for glucosamine and galactose. The following differences as compared with the urine substance were observed: the negative Tollens' reaction for uronic acids, the failure to give a precipitate with basic lead acetate, and notably, the considerably higher serological activity.

Landsteiner, K., and R. A. Harte, 1941. GROUP-SPECIFIC SUBSTANCES IN HUMAN SALIVA. *Jour. biol. Chem.*, 140 (2): 673-674.

Saliva collected from subjects belonging to blood groups A, B, and O was heated and evaporated at room temperature to a small volume. After treatment with alcohol and centrifugation, an average of 15 mg. of material from 500 cc. portions was obtained. On a dry weight basis the substances were 40 times as active as inhibitors of isoagglutination as the total solids of saliva; complete inhibition under testing conditions previously described (cf. Landsteiner, 1936m) was seen with dilutions of 1:4,000,000 to 1:8,000,000.

The preparations were analyzed for certain chemical constituents and results are as follows for groups A, B, and O, respectively: total N, 5.65, 5.33, 5.74%; amino-acid N, 2.48, 2.35, 2.91%; hexosamine N, 1.81, 1.71, 1.68%; hexosamine, 23.3, 21.7, 21.5%; reducing sugar as glucose, 45.5, 48.5, 46.5%; and ash, 0.76, 0.90, 1.91%. (cf. Hart, 1947).

Langford, George C., Jr., John E. Faber, Jr., and Michael J. Pelczar, Jr., 1950. THE OCCURRENCE OF ANAEROBIC GRAM-NEGATIVE DIPLOCOCCI IN THE HUMAN MOUTH. *Jour. Bacteriol.* 59 (3): 349-356.

Two ml. saliva samples from 51 apparently normal persons were collected and decimal dilutions in thioglycolate medium to 10^{-7} were made within 1 hour after collection. With 1 ml. of the 10^{-6} and the 10^{-7} dilutions, cultures were made. The plates, each of which had received approximately 5 ml. of trypticose soy agar, were mixed by rotation. After hardening, the plates were placed in jars under anaerobic conditions, and incubated for 48 hours at 35°C. Representative colonies of all types found were examined for Gram reaction and morphology.

A comparison of the isolated organisms with the reference organisms led to the suggestion that Bergey's description of *Veillonella* needs to be amended to read "anaerobic Gram negative diplococci" [instead of cocci], since examination with light and electron microscopes showed that the description does not conform to actual appearance. It is, at the same time, advisable to discard the designation *Neisseria* for any anaerobic Gram negative diplococci.

Tables are given of biochemical reactions of reference cultures of anaerobic gram-negative cocci of those isolated from the normal human mouth.

Langley, J. N., 1878. ON THE PHYSIOLOGY OF THE SALIVARY SECRETION. I. THE INFLUENCE OF THE CHORDA TYMPANI AND SYMPATHETIC NERVES UPON THE SECRETION OF THE SUB-MAXILLARY GLAND OF THE CAT. *Jour. Physiol.*, 1: 96-103.

A comparison is presented on the nature of the secretory action in the dog and in the cat. Contrary to results of studies on the dog, observations on the cat indicated that the chorda secretion was more viscid than the sympathetic, atropin paralysed the secretory function of both the chorda and the sympathetic nerve, and the sympathetic and chorda were not antagonistic for minimal or maximal stimuli.

Langley, J. N., 1878a. ON THE PHYSIOLOGY OF THE SALIVARY SECRETION. II. ON THE MUTUAL ANTAGONISM OF ATROPIN AND PILOCARPIN, HAVING ESPECIAL REFERENCE TO THEIR RELATIONS IN THE SUB-MAXILLARY GLAND OF THE CAT. *Jour. Physiol.*, 1: 339-369.

A study was made of the mutual antagonistic action of atropine and pilocarpine in the sub-maxillary gland of the cat. It is concluded that only an imperfect mutual antagonism exists, the pilocarpine neutralizing to some extent the effect of the atropine.

Langley, J. N., 1885. THE "PARALYTIC" SECRETION OF SALIVA. *Proc. Roy. Soc. London*, 38 (236): 212-215.

The physiological and histological changes of the submaxillary glands resulting from ipsilateral chorda section are described and discussed with special emphasis upon possible "cause-effect" relationships.

Langley, J. N., and H. M. Fletcher, 1888. ON THE SECRETION OF SALIVA, CHIEFLY ON THE SECRETION OF SALTS IN IT. *Proc. Roy. Soc. London*, 45 (273): 16-18.

Heidenhain's "law" (an increased salt content percentage accompanies an increased salivation rate) is verified, and the effects of various stimulatory agents on the salt, water, and organic content of the salivary secretion are discussed.

Langley, J. N., and H. M. Fletcher, 1889. ON THE SECRETION OF SALIVA, CHIEFLY ON THE SECRETION OF SALTS IN IT. *Philos. Trans. Roy. Soc., London*, 180 (B): 109-154.

The percentage of salivary salts, as well as the amount of organic substances were noted and described during the salivary-secretory responses of dogs under the following conditions: sympathetic and chorda stimulation, dyspnea, occlusion of the carotid artery, bleeding, and injections of

dilute and strong salt solutions, pilocarpine, atropine, sodium carbonate, lithium citrate, potassium iodine, and potassium ferrocyanide.

Langley, L. L., C. H. Gunthorpe, and W. A. Beall, 1958. SALIVARY GLUCOSE THRESHOLD. *Amer. Jour. Physiol.*, 192 (3): 482-484.

The glucose threshold for the canine parotid gland was investigated in 10-12 kg. dogs under Nembutal anesthesia while receiving intravenous infusion of glucose. Pilocarpine was injected subcutaneously to maintain salivation at approximately 0.2 cc./min. Glucose determinations were made, by the Anthrone method, of saliva collected each 10 minutes and of blood drawn midway in each collection period. Results show that glucose appears in parotid saliva when the blood glucose concentration is raised to 512 ± 51.5 mg.%, and disappears from the saliva when the blood glucose concentration returns to about this level after being elevated to higher concentrations. The salivary glucose threshold was raised to 1235 ± 26.9 mg.% when administration of 80 U of insulin intravenously was followed by an additional 720 U in the glucose infusion over 1-2 hour period. Glucose was found in parotid saliva at the fasting blood sugar level of 269 ± 13.4 mg.% in dogs made diabetic by the alloxan technique. The action of insulin and of adrenalin in altering the salivary gland glucose threshold is discussed.

Langley, L. L., C. H. Gunthorpe, and W. A. Beall, 1958a. Parotid clearance of sodium and potassium. *Amer. Jour. Physiol.*, 195 (3): 693-696.

The mechanism of saliva production by the parotid gland was investigated in 10-12 kg. dogs under Nembutal anesthesia while receiving subcutaneous injections of pilocarpine to stimulate salivary gland activity. Salivary samples were collected from the catheterized duct to determine flow rates, while concentrations of Na and K in saliva and plasma were determined by flame spectrophotometer. Plasma K was increased by intravenous infusion of 1% KCl; plasma Na was altered by similar infusion of 10% NaCl. Results show the Na concentration in parotid saliva to be always lower than in the plasma and the salivary concentration of K to be always higher. The salivary concentration of Na was found to vary directly with the flow rate over a very wide range, whereas the K concentration varied indirectly with flow at rates up to about 0.2 cc./minute; the K concentration of the saliva at higher flow rates was independent of the rate and closely approximated the K concentration of the plasma. Increase in the Na concentration of the plasma produced by the NaCl infusion was paralleled by an increase in the salivary concentration of Na; extrapolation of data indicates the salivary Na threshold to occur at about a plasma Na concentration of 100 mEq/L. The Na infusion also produced a rapid significant decrease in parotid flow. Infusion of KCl showed the salivary K/plasma K ratio to be independent of the plasma concentration of K; the infusion increased the salivary rate of flow. The salivary flow-rate effects subsided when intravenous infusion of NaCl or KCl was stopped.

Lapina, I. A., 1953. O ĬAVLENIĬAKH IRRADIATSII VOZBUZHDENIĬA V SLIUNOOTDELITEL'NOM TSENTRE.

[Concerning the irradiation of stimulation in the center of salivary secretion]. *Fiziol. Zhur. SSR*, 39 (3): 275-277.

Experiments were conducted in dogs in which a small portion of the right or the left side of the tongue was surgically exposed to the neck and a drop of .05 N HCl solution was applied to the exposed portion of the tongue. The findings prove that in case of unilateral application of a strong stimulant on one of the tongue portions the stimulation of the salivary secretion center on the same side irradiates to the center of the opposite side and produces secretion from both glands. After repeated stimulation and resultant excitation of the salivary centers, the stimulation produces only an ipsilateral salivary response. The ipsilateral response ceases after 24 hours.

Lapina, I. A., 1954. OBRAZOVANIE USLOVNOGO SLIUNNOGO REFLEKSA PRI PODKREPLENII KOMPLEKSNYM BEZUSLOVNYM RAZDRAZHITELEM [Formation of the conditioned salivary reflex with consolidation by complex unconditioned stimulation]. *Fiziol. Zhur. SSSR*, 40 (6): 681-683.

The formation of the conditioned salivary reflex upon complex unconditioned stimulation was studied in one dog; Abuladze's method was used. The conditioned reflex was elicited by the sound of a metronome at 120 strokes/min., and consolidated by hydrochloric acid in different concentrations, acting simultaneously on bilateral portions of the tongue.

The unconditioned reflex appeared in both parotid glands simultaneously. In 50 experiments the reflexes were equal on both sides.

The stimulations of a weak hydrochloric acid concentration on the right side and a strong concentration on the left were then applied simultaneously: the conditioned reflex appeared only in the left gland. However, as soon as the strong component of the complex unconditioned stimulation was removed, the conditioned reflex reappeared on the side of the weaker stimulation.

The application of one strong component of complex unconditioned stimulation produces a lesser conditioned reflex than the combined complex consolidation. The conditioned reflex, worked out on the basis of complex consolidation, always gives a conditioned reflex in the gland ipsilateral to the tongue portion which received the strong unconditioned stimulation.

The conditioned stimulation (metronome) was then combined with the simultaneous action of a strong HCl concentration on bilateral portions of the tongue. Strongly increased conditioned reflexes were obtained on both sides. The conditioned reflex produced through complex consolidation increased in strength with the strength of the complex stimulant.

The author concludes that a strong unconditioned stimulant elicits a strong focus of stimulation which apparently leads to a lessening of stimulation in the other regions of the hemispherical cortex; the weak unconditioned stimulation becomes subliminal and the conditioned stimulation is directed to the side of the strong unconditioned stimulant.

Lapina, I. A., 1955. IZMENENIE LATENTNOGO PERIODA BEZUSLOVNOI SEKRETSII POSLE UGASHENIĬA OBNOSTORONNIKH USLOVNYKH REFLEKSOV [Changes in the period of latency of unconditioned secretion

after extinction of unilateral conditioned reflexes]. *Biüll. eksper. Biol. Med., Moskva*, 39 (5): 3-4.

The changes in the periods of latency prior to salivary secretion were studied in 2 dogs by Abuladze's method (portions of the third back part of the tongue are exposed operatively). This method permits production of unilateral conditioned reflexes in the animal by combining indifferent stimuli with an unconditioned stimulus, applied to one of the exposed tongue portions. Sounds were used as indifferent conditioned, hydrochloric acid as unconditioned stimulants.

After extinction of the conditioned reflex, the inhibition it had produced spread to the conditioned salivary reflexes which formed on the basis of the ipsilateral unconditioned reflex. This inhibition persisted during the experiment, it weakened, but disappeared completely only after 24 hours. The restoration of the extinct conditioned reflex was not obtained at once. In all experiments of active reflex restoration the following rules became manifest: after extinction of the unilateral conditioned reflex, the unconditioned stimulant elicits secretion only after a 25 to 30-second period of latency. This value varies depending on the time elapsed after the extinction of the conditioned reflex; the longer the time lapse, the shorter became the period of latency of the unconditioned secretion with active restoration of the extinct conditioned reflex. The conditioned reflex always reappears after the period of latency has reached 2 to 5 seconds. (From author's summary)

Larson, P. S., 1935. ON THE ALLEGED OCCURRENCE OF ACETYLCHOLINE AND ADRENALIN IN CAT'S SALIVA. *Jour. Pharmacol. exper. Ther.*, 54 (3): 341-345.

The author investigated whether the pressor or depressor effects produced by injection of fresh saliva [cf. Secker, 1934m,n; Gibbs, 1935m] were due to the presence of some simple soluble substance (adrenalin, acetylcholine, etc.). Protein-free ultra-filtrates of fresh saliva were used.

The method, fully described, consisted primarily of intravenously injecting cat's saliva, or saliva filtrates to which either adrenalin or acetylcholine had been added, into cats.

In 9 of 10 experiments, neither the pressor nor the depressor substance passed through the filters; the exception was attributed to a faulty filter. Both acetylcholine and adrenalin were equally filtrable.

The effects of the various intra-venous injections of diluted saliva on blood pressure led the author to conclude that:

"1. Ultra-filtrates from fresh saliva do not possess vascular activity.

"2. Protein-free filtrates containing acetylcholine or adrenalin previously added to saliva can be obtained.

"3. The vascular effects of whole saliva are due neither to acetylcholine or adrenalin." (From author's conclusions.)

Lashley, K. S., 1916. REFLEX SECRETION OF THE HUMAN PAROTID GLAND. *Jour. exper. Psychol.*, 1 (6): 461-493.

An apparatus for obtaining salivary secretion of the parotid glands in man is described (cf. p. 462-463). The instrument "consists of a metal

disc 18 mm. in diameter in which two concentric chambers, *a* and *b*, are cut. The inner of these is 10 mm. in diameter and 3 mm. deep; the outer, in the form of a circular groove, is 2 mm. wide and 3 mm. in depth. The two chambers open through the back of the disc into two separate tubes, *c* and *d*, of about 2 mm. bore and 15 cm. length. The tubes are of silver, soft-drawn for greater flexibility, and the disc is heavily silver-plated. In use, the instrument is placed against the inner surface of the cheek so that the central chamber covers the mouth of Stenson's duct and the air is exhausted from the outer chamber by a suction pump, when the disc clings tightly to the cheek. The saliva is free to flow into the central chamber and thence through the tube, *c*, to a suitable measuring device, without constriction of the duct or unusual resistance. When the mouth is closed the tubes lie between the cheek and the upper molars and pass out through the corner of the mouth."

Lashley, K. S., 1917. CHANGES IN THE AMOUNT OF SALIVARY SECRETION ASSOCIATED WITH CEREBRAL LESIONS. *Amer. Jour. Physiol.*, 43 (1): 62-72.

Examination of salivary reflexes were made in nine patients with more or less fully developed hemiparesis or hemiplegia. The method used for collecting the secretion of the parotid gland has been described previously (Lashley, 1916m). Observations were made on (1) tests of the volume of secretion with stimulation; (2) tests of the reflex secretion of ordinary gustatory stimuli; (3) in various attempts to induce inhibition of secretion; and (4) tests of possible conditioned reflexes. The author concludes that the data at hand are not extensive enough to justify any general conclusion as to the relation of the abnormal secretion to the other symptoms of motor paralysis. There seemed to be no constant relation between the abnormal secretion and facial paralysis. There was little evidence to indicate an increase in salivary reflexes, resulting from lesions in the nervous system, which might be comparable to the increase in tendon reflexes. The reflexes to dilute acids in no case exceeded those which have been found in normal individuals.

Laschtschenko, , 1899. UEBER LUFT-INFECTIOIN DURCH BEIM HUSTEN, NIESEN, UND SPRECHEN VERSPRITZTE TROPFCHEN [On air-borne infection by droplets sprayed by coughing, sneezing, and talking]. *Zeitschr. f. Hyg. u. Infektionskrankh.*, 30 (1): 125-138.

Experiments were made to determine if, and to what extent, infectious bacteria are air-borne.

An experiment was conducted in a disinfected glass case. The mouths of test persons were rinsed with concentrated washings of *Bacillus prodigiosus* [*Serratia marcescens*]. 12 agar plates were placed at various distances from each test person, and he was asked to speak in a soft voice. Each such test took approximately 20 to 60 minutes. The plates remained exposed to the atmosphere of the case for approximately another hour to receive any bacteria that might still be settling from the air. They were then incubated for 3 days at 22° C. The results were slightly positive, yet completely negative when conducted in a larger room.

Similar experiments, in which the test person spoke in a normal conversational voice, a loud

voice, or in which he coughed, or sneezed, gave decidedly positive results. Tables offering the number of test persons, the distance of plates, colonial growth count, etc., are given.

By wiping the mucous membrane of the cheeks and of the soft palate with cotton and microscopically examining the wipings, it was found that 9 of 20 phthisics had tubercle bacilli in their mouth secretions.

Five sterile petri dishes with saline solution were placed in a glass case at distances varying from the level of the head of the test person to 90-170 cm. away. With all sterile precautions, the phthisic patient entered the case and remained for 1 to 1-1/2 hours. At the end of this time, the bacterial contents of the dishes were injected into guinea pigs. Of 9 test persons, 4 gave positive results as tuberculosis transmitters.

Further experiments were made by drawing the air from the glass case through a bottle with saline solution. No conclusive results, however, were obtained.

Latimer, Caroline W., and J. W. Warren, 1897. ON THE PRESENCE OF THE AMYLOLYTIC FERMENT AND ITS ZYMOGEN IN THE SALIVARY GLANDS. Jour. exper. Med., 2 (5): 465-473.

A study was made of extracts of the salivary glands of dogs, cats, pigs, opossum, rats, mice, rabbits, ox, and sheep to determine qualitatively the presence of the amylolytic ferment (ptyalin) and its zymogen (ptyalinogen). The zymogen was found to exist in the salivary glands of dogs, cats, sheep, and possibly the ox.

Lattes, E., 1936. RICERCA DEL MYCOBACTERIUM TUBERCULOSIS NELLA SALIVA E NELLE FECI DI BAMBINI FIGLI DI TUBERCULOTICI SENZA SINTOMI DI LESIONI PULMONARI [Study of Mycobacterium tuberculosis in the saliva and the feces of children of tuberculous parents, without symptoms of pulmonary lesions]. Gior. di Batteriol. Immunol., 16 (3): 454-457. In Italian, with French, German, and English summaries (p. 456-457).

The salivas of 19 children (age, 3 to 12 years) of tuberculous parents were examined. None of the children had symptoms of pulmonary lesions, though 16 gave positive tuberculin reaction. The saliva was consistently negative for Mycobacterium tuberculosis.

Laub, Hans, 1934. ÜBER DAS VORKOMMEN VON PSEUDODIPHThERIEBAZILLEN IM SPEICHEL VON MENSCHEN UND DIE FRAGE DER UMWANDLUNG SOLCHER PSEUDODIPHThERIEBAZILLEN IN ECHTE DIPHThERIEBAZILLEN [On the occurrence of pseudodiphtheria bacilli in the saliva of man and the question of transformation of such pseudodiphtheria bacilli into genuine diphtheria bacilli]. Arch. f. Hyg., 112 (4): 222-233.

Saliva samples from healthy individuals were examined for the presence of pseudodiphtheria bacilli [Corynebacterium pseudodiphtheriticum] and the possibility of a transformation of these organisms into genuine diphtheria bacilli [C. diphtheriae] was studied. 80 (76.8%) of 104 samples were positive for the microorganisms. Only 7 of approximately 64 pure cultured pseudodiphtheric organisms were transformable into organisms morphologically and culturally similar to diphtheria bacilli, and these by 49 to 88

sub-cultures on 5% blood agar; none of the 7 strains, however, developed the pathogenicity of genuine diphtheria bacilli for animals.

Law, David B., and L. S. Fosdick, 1941. THE RATE OF PUTREFACTION OF SALIVA IN RELATION TO PERIODONTOSIS. Jour. dental Res., 20 (3): 266-267.

"The rate of putrefaction of saliva from periodontosis and normal cases was measured by means of the osmoscope and by Sorenson's titration. Saliva was gathered from normal and periodontosis individuals and was immediately incubated at body temperature. The pO value of the freshly collected saliva and at half hour intervals was measured and recorded. Final titrations were made on the same type of saliva immediately after secretion and after incubating at body temperature at the same intervals. It was found that the saliva from individuals with periodontosis had an initially higher pO value than did normal patients and the rate of putrefaction as measured by the osmoscope was faster in the saliva from those individuals suffering from periodontosis. The degree of proteolysis as measured by the final titration indicated that proteolysis was greater in the individuals suffering from periodontosis than in the normal cases. On the basis of these experiments it was concluded that putrefaction may be a factor in periodontosis." (Complete paper.)

Law, D. B., M. Berg, and L. S. Fosdick, 1943. CHEMICAL STUDIES ON PERIODONTAL DISEASE. I. Jour. dental Res., 22 (5): 373-379.

The rate of putrefaction of salivary protein of paraffin-stimulated salivas from 163 normal and 145 pathological mouths (periodontosis) was studied over a three-hour period by osmoscope and by formol titration. In general, the saliva from the diseased mouths decomposed more rapidly than the saliva from the healthy ones, but individual variations were so great as to decrease the value of the data considerably.

Lawrence, John H., and Donald E. Dial, 1932. EFFECTS OF INTRAVENTRICULAR INJECTIONS OF PITUITRIN AND PILOCARPINE IN DOGS. Proc. Soc. exper. Biol. and Med., 30 (1): 49-54.

Dogs were anesthetized by morphine and chloralose, morphine and ether, or novocaine, and pilocarpine or pituitrin was introduced (by fluid replacement) into a lateral ventricle. Rectal temperature, pulse, respiratory rate and character, panting, salivation, emesis, diarrhea, and changes in pupillary size were noted at 15 minute intervals.

Observations indicated that salivation occurred, when no anesthesia was administered, after intraventricular injections of pilocarpine or pituitrin, but that pilocarpine initiated the most rapid and most pronounced salivation of the two substances. The action of pilocarpine was similar whether administered intraventricularly, intramuscularly, or subcutaneously, however, subcutaneous injections of pituitrin produced no significant reactions.

Data suggested that there are marked differences in the responses of man and dogs to pilocarpine and pituitrin.

Lawyer, Arlette, and Basil G. Bibby, 1946. SOME OBSERVATIONS ON THE USE OF STREPTOTHRYCIN IN PROTECTING CHICKEN EMBRYOS AGAINST INFECTION BY SALIVARY BACTERIA. Jour. dental Res., 25 (3): 181-182.

"Study was designed to test whether chicken embryos might be useful as a means of evaluating usefulness of antibacterial agents intended for use in close proximity to dental pulp. Eggs were incubated at 37°, opened on the 11th day and injected on 13th. Chorio-allantoic membrane was inoculated with 0.5 cc. of saliva and 0.5 cc. of streptothrycin (250 units per cc.) injected intravenously. All 5 of the embryos not protected with streptothrycin died. Eighteen of 22 injected with fresh streptothrycin survived. The percentage of survival diminished progressively in 63 embryos treated with solutions stored for 3, 6, 8, 10 and 13 days at room temperature. Histological examination of sections from the surviving embryo revealed no abnormal tissue reactions. Comparisons were made of effect of local applications of streptothrycin and Morson's creosote on 80 chorio-allantoic membranes infected with 0.5 cc. of saliva. Full strength, 6000, 600, 250, and 120 unit concentrations of streptothrycin, and full strength, 50%, 25%, and 1% creosote were used. Streptothrycin and Morson's creosote in high concentrations were injurious to embryo tissues. However, only streptothrycin exerted pronounced bactericidal effect in dilutions well tolerated by tissue. Comparisons were made of the effects of streptothrycin and penicillin injected into allantoic space of embryos. Neither 0.5 cc. of 250 unit solutions of penicillin or streptothrycin produced changes in 9 embryos. However, 0.5 cc. of 10,000 unit concentrations in 10 embryos caused death of 5 of 10 of the streptothrycin treated embryos and 3 of 10 penicillin treated embryos. These showed comparable pathosis, indicating that comparable concentrations of streptothrycin and penicillin have similar effects on chick embryos." [Complete copy.]

Lawyer, Arlette, Basil G. Bibby, and Helmut A. Zander, 1946a. SOME OBSERVATIONS RELATING TO THE USE OF STREPTOTHRYCIN IN THE MOUTH. Jour. dental Res., 25 (3): 181-182.

Salivary organisms were streaked onto plates containing progressive dilutions of streptothrycin, to test *in vitro* effectiveness of the antibiotic. Complete inhibition of organisms occurred when 25 units per cc. streptothrycin in horse blood agar was used. The critical dilution of the antibiotic, which just permitted streptococcal types to grow, was 0.4 units per cc. Yeast grew at 3.1 units per cc. Storage at room temperature for 15 days removed the effectiveness of 250-unit streptothrycin solutions. Storage at ice box temperatures did not affect the solutions up to 19 days. Cultures from carious dentin and tooth surfaces of freshly extracted teeth immersed in 250 units streptothrycin solutions for 2 hours were negative.

The usefulness of streptothrycin as a cavity dressing was compared with that of Morson's creosote. Both substances were mixed with zinc oxide and imbedded into agar plate cultures. Colony-free inhibition zones of the same width occurred on all plates. Streptothrycin was, however, more effective than creosote. When zinc oxide mixtures containing 250 units of streptothrycin or creosote

were each sealed in 3 freshly prepared sound cavities and 2 carious cavities, the carious cavities treated with streptothrycin became sterile, while those treated with creosote yielded mixed cultures. 12 days after deep cavities of a young dog were treated with 250 units of streptothrycin per cc. zinc oxide, with creosote and zinc oxide, or with zinc oxide alone, the streptothrycin-treated pulps were perfectly healthy, while there were signs of mild irritation in those treated with creosote. Clinical tests of the effect of bactericidal concentrations of streptothrycin (250 units of zinc oxide streptothrycin for 3 to 5 days) showed a reduction of bacterial growth in two carious cavities; a similar cavity dressed with streptothrycin for 1 to 4 days proved to be sterile. Using zinc oxide streptothrycin for root treatment produced no periapical reaction and streptothrycin in agar for dressing an alveolotomy gave a favorable result, although sterility was not maintained.

Le Roy, Bernard R., 1908. COLORIMETRIC ANALYSIS OF THE SALIVA, WITH THE CLINICAL SIGNIFICANCE. New York Med. Jour., 87 (10): 448-450. (Abstr.) Jour. Amer. med. Assoc., 50 (12): 991. 1908.

A detailed description is given of the analytical processes that may be utilized on saliva to detect the presence of sulphocyanides, ammonia, chlorides, oxalic acid, urea, formaldehyde, acetone, sodium, potassium, calcium, nitrites, lactic acid, opium, and morphine. Rosalic acid paper for testing acids and alkalies and a test for protein are also described. All the tests are qualitative, and all of the reagents are diluted to 5% strength.

The absence or presence of the above mentioned substances in the saliva is indicated to be of clinical significance in such conditions as diseases of the nervous system, fevers, rhinitis, catarrhs, sepsis, auto-infections, rheumatism, chronic skin diseases, nephritis, electrolyte imbalances, and cardiac, kidney, or brain lesions.

Leach, Charles N., and Harold N. Johnson, 1940. HUMAN RABIES, WITH SPECIAL REFERENCE TO VIRUS DISTRIBUTION AND TITER. Amer. Jour. trop. Med., 20 (2): 335-340.

The case-histories are presented of six individuals (male and female) infected with rabies; the distribution as well as the titer of the virus in nerve and glandular tissues of three cases are given. Varying degrees of salivation were noted in the subjects before death, but in only one (a 14 year-old female) could the presence of the virus in the salivary glands be detected.

Leffkowitz, Alice, 1928. UNTERSUCHUNGEN ÜBER DIE AUSSTREUUNG INFEKTIOSE TRÖPFCHEN BEI DIPHTHERIE [Studies on the dissemination of infectious droplets in diphtheria]. Zeitschr. f. Hyg. u. Infektionskrankh., 109 (1): 137-143.

The dissemination of diphtheria bacilli [*Corynebacterium diphtheriae*] into the environmental air was studied in 49 acute cases of diphtheria: 15 of 89 cough plates taken of the patients were positive. That this number may not offer an accurate picture is suggested by the fact that 22 of the 49 cases were in advanced stages; 13 (or 58%) of the pour-plates from these

advanced cases were positive for diphtheria bacilli. In general, cultural studies showed the significance of droplet infection to be much greater in the early stages than in the 2nd and 3rd weeks.

Two saliva samples from 16 diphtheritics contained diphtheria bacilli; the air in the sick-rooms was consistently negative.

The author concludes that while air-borne transmission of diphtheria is possible, it is not of the same significance as that of influenza or whooping cough.

Lehrs, Hugo, 1930. UEBER GRUPPENSPEZIFISCHE EIGENSCHAFTEN DES MENSCHLICHEN SPEICHEL [On group-specific properties of human saliva]. Zeitschr. f. Immunitätsforsch., 66 (1/2): 175-192.

"1) The salivas of 40 persons were studied for the presence of group-specific inhibitory action. In agreement with Yamakami and others, [the existence of such an action] was proven by inhibition of isoagglutination, also by inhibition of "isolysis". At times, the quantitative relationships were studied by tests with constant serum and decreasing amounts of saliva, at other times with constant amounts of saliva and increasing serum dilutions. Considerable differences in reaction occurred among the various test persons. If the inhibitory substances are present only in minute amounts, their determination is possible only by careful examination of the quantitative relationships.

"In 2 test persons, the individual variations over a 5-month period were very slight.

"2) The corresponding group-specific immuno-agglutinins were obtained by immunization with saliva samples of Groups A and B.

"After immunization with saliva of Group A, specific sheep hemolysins were found in 2 cases even in the adsorption test. The group substances A and B are contained in saliva as in the form of antigens the Group A including its sheep fraction." (Author's summary, translation.)

Lejeune, J., 1946. CONTRIBUTION NOUVELLE À L'ÉTUDE DES SÉCRÉTIONS DES ANTIGÈNES DE GROUPES PAR LA SALIVE [A new contribution to the study of secretions of group antigens by saliva]. Compt. rend. de la Soc. de Biol. (Paris), 140 (19-20: 816-817.

Examination of saliva of persons belonging to blood groups A, B, and AB indicate that the antigens A, B, and O are secreted by the salivary glands. The authors consider that the saliva may secrete these antigens if they are first freed in the plasma by physiological destruction of the blood cells in the organism. Secretion of substance O always was coupled to secretion of substance A or B, and never secreted alone. A subgroup A was distinguished in which the antigenic structure, a union of A and O, was permanent.

Lenkeit, W. 1933. NEUERE ERGEBNISSE DER VERGLEICHENDEN PHYSIOLOGIE DER VERDAUUNG DER SÄUGETIERE [New results in the comparative physiology of the digestion of mammals]. Ergeb. Physiol., 35: 573-631.

The extensive review article contains a section (pp. 580-588) on saliva. The salivary glands, secretion and composition of the saliva is discussed in detail.

Lenz, A. K., and A. A. Smirov, 1927. METODIKA USLOVNYKH SLIUNOOTDELITEL'NYKH REFLEKSOV V PRIMENENII K VZROSLYM LIUDIAM [The conditioned salivary reflex method applied to adult people]. Mediko-biol. Zhur, 1: 112-128.

The adaptability of the conditioned salivary reflex technique, used to study the higher nervous functions in dogs, was examined for similar use in adult human subjects. Modifications of the experimental set-up and of the Lashley funnel for collection of saliva are described. Candy or biscuit were used as unconditioned saliva stimulants except in a few mental patients who required use of dilute hydrochloric acid. Conditioned saliva responses were established to various sound or light stimuli. The results indicate the conditioned reflex method, even in its preliminary form, is fully applicable to the study of human higher nervous functions.

Leonard, Harold J., 1928. THE CAUSE OF VARIATIONS IN SALIVARY CALCIUM; THEIR RELATION TO SUSCEPTIBILITY AND IMMUNITY TO DENTAL CARIES. Jour. Amer. dental Assoc., 15 (8): 1530-1535.

A review of literature is presented on salivary calcium content and its relation to dental caries. Two series of calcium determinations were made, using a modification of the method of Clark-Collip: one, a series of determinations taken from time to time on the paraffin-stimulated saliva of the same person (having a "fair degree of immunity" to caries), and the other, a few examinations of resting saliva coupled with examinations of paraffin-stimulated samples. In the former test, calcium values ranged from an average of 6.0 to 11.8 mg./100 cc. saliva; in the latter, a pair of values was 6.40 mg. (resting) and 7.19 (stimulated), and another pair, 6.56 and 6.26 mg., respectively. No correlations were established nor was any explanation offered for the cause of the variations in the calcium content.

Leonard, Harold J., and Vaman R. Kokatnure, 1939. THE PRESENCE OF PEROXIDIC COMPOUNDS AND CATALASE IN HUMAN SALIVA AND THEIR RELATION TO DENTAL CARIES SUSCEPTIBILITY. Preliminary report. Jour. dental Res., 18 (3): 238-239.

"The presence of peroxidic compounds in saliva is proved by test. Test consists of taking 5 cc. of unstimulated saliva and immediately adding 10 cc. of 99 per cent iso propyl alcohol, 2 cc. glacial acetic acid and 1 cc. of 50 per cent KI. Liberated iodine is titrated with N/20 sodium thio sulphate. Estimations on saliva of 37 individuals were made in which caries activity was carefully determined. Separate 5 cc. samples of unstimulated salivas from the same individuals were studied at the same time for catalase activity. 1 cc. of 1 per cent H₂O₂ was immediately added to saliva, allowed to stand 5 minutes, then heated to stop catalase activity and tested as above for peroxidic compounds undestroyed by catalase. It is found that, within limits, the H₂O₂ is broken down to a percentage which is constant for that saliva whether much or little peroxide is used. While no correlation existed between peroxidic compounds found or per cent of peroxide remaining after 5 minutes, and caries activity, it was found that a factor made by combining the 2 was correlated in 80 per cent of the

cases. Since peroxidic compounds definitely inhibit acidophilus growth, it is suggested that herein is an explanation for acidophilus freedom in some caries-free individuals." (Complete paper.)

Leriche, R., 1917. SUR LE TEMPS PERDU POUR L'ARRET DEFINITIF DE LA SECRÉTION PAROTIDIENNE APRÈS ARRACHEMENT DE L'AURICULO-TEMPORAL [On the time lag after cutting the auriculo-temporal nerve before definitive stopping of parotid secretion]. *Compt. rend. de la Soc. de Biol. (Paris)*, 80 (8): 370-371.

Examination of several case histories showed that arrest of parotid secretion can be immediate and final following the sectioning of the auriculo-temporal nerve, but usually takes 5 days, occasionally longer, to occur.

Leulier, A., R. Sohier, and G. Nouvel, 1947. SALIVE PAROTIDIENNE ET SALICYLATE DE SODIUM [Parotid saliva and sodium salicylate]. *Compt. rend. de la Soc. de Biol. (Paris)*, 140 (21-22): 874-875. 1946 (publ. 1947).

The relationship between the amount of sodium salicylate in the blood and in parotid saliva of both healthy subjects and in mumps patients was studied 1-1/2 hours after ingesting 6 g. of the salicylate. Among normal subjects, 56% showed a concentration of the salicylate in the saliva between 0.30 and 0.45 of that of the blood serum; 12% showed a concentration of less than 0.03. Among subjects with mumps 53% showed a concentration in the saliva less than 0.03 of that in the serum. The permeability of the parotid gland of the patients returned to a normal level with return to normal health.

Leung, S. Wah, 1946. CHANGES IN THE SALIVARY VOLUME AND pH WITH CHANGES IN OXYGEN CONTENT OF THE INSPIRED AIR. *Jour. dental Res.*, 25 (3): 170.

"Partial anoxia was produced in human subjects by decreasing the oxygen tension in the inspired air. Breathing of the gas mixture, held in a 500 liter spirometer, was made possible through a system of tubing and a mask covering the nose and mouth. Saliva was collected through the mask by means of a special funnel arrangement. Measurements of the salivary rate of flow and salivary pH showed definite changes in both of these properties with a trend toward lowering magnitude. These changes appear to be subject to individual variations." (Complete paper.)

Leung, S. Wah, 1948. INFLUENCE OF CO₂ ON THE SOLUBILITY OF CALCIUM IN SALIVA. *Jour. dental Res.*, 27 (6): 738.

"In the course of investigating the possible mechanism of oral calculus formation, the influence of salivary CO₂ on the solubility of salivary Ca was studied. Paraffin-stimulated saliva was collected under oil 1 to 2 hours after breakfast and divided into 4 portions. One portion was immediately analyzed for Ca and CO₂ content and served as the control. Portions II and III were centrifuged at 3500 r.p.m. for 30 minutes, protected and unprotected by liquid paraffin, respectively, and the supernatant analyzed for the above constituents. Portion IV was bubbled for 10 minutes with CO₂-free compressed air in order to remove as much of the CO₂ as possible and then was centrifuged and analyzed. The results

indicate that centrifugation, per se, will cause the loss of small amounts of CO₂ (2-3 per cent) and the precipitation of some Ca (4 per cent). The mechanical removal of larger amounts of CO₂ (28 per cent) will result in the precipitation of a considerable quantity (33 per cent) of Ca normally in solution. The solubility of salivary Ca, therefore, appears to depend in some measure on the CO₂ content." (Complete paper.)

Leung, S. Wah, 1951. A DEMONSTRATION OF THE IMPORTANCE OF BICARBONATE AS A SALIVARY BUFFER. *Jour. dental Res.*, 30 (3): 403-414.

The buffer values of eleven stimulated saliva samples from nine individuals, pH between 7.2 and 6.8, were calculated by the method of Van Slyke (described in full). The extreme limits of the total buffer values (at pH 7.0) for mixed human saliva ranged from 0.0060 mole/liter to 0.0437 mole/liter, most values falling within much narrower limits, 0.0257 and 0.0380. The average total buffer value was 0.0263 mole/liter. The carbonic acid-bicarbonate system constituted the most important buffer in saliva, about 85% of the total value being attributable to this system.

When the buffer values for dog parotid (pH 7.7) and submaxillary (pH 7.3) paraffin-stimulated saliva samples were tabulated, over 95% of the total buffer capacity in each was due to the carbonic acid-bicarbonate system. The average values for the parotid saliva of three dogs were: total buffer value, 0.0485 mole/liter; H₂CO₃-BHC₃, 0.0025; and other buffers, 0.0016 mole/liter. The average values for submaxillary saliva of three dogs were 0.0331, 0.0025, and 0.0011, respectively.

A comparison was made of the buffer values of animal tissues with those of saliva (cf. Table III).

Leung, S. Wah, 1953. A NEW METHOD FOR THE IN VITRO PRODUCTION OF ARTIFICIAL CALCULUS. *Jour. dent. Res.*, 32 (5): 689-690.

A new method for the in vitro production of artificial calculus is discussed. This method is based on the principle of cyclic partial drying of the tooth surfaces rather than continual immersion in saliva. The deposits are said to be similar to clinical calculus in organic and moisture content and in calcium and phosphorus concentrations.

Leung, S. Wah, and P. V. Morgan, 1953a. CALCULUS FORMATION FROM SALIVA AS INFLUENCED BY AN ALTERED BACTERIAL FLORA. *Jour. dent. Res.*, 32 (5): 690.

A comparison was made of the calculus-producing ability of (1) chemically sterilized saliva, using mercuric chloride, (2) saliva inoculated with heavy suspensions of dextrose-starch broth cultures of 3 different organisms isolated from cases of clinical calculus, and (3) normal untreated saliva. Mercuric chloride sterilization did not inhibit calculus formation by the saliva and the addition of organisms isolated from calculus did not enhance calculus formation. It is noted, however, that the organisms were not used in the numbers or proportions present in natural calculus deposits.

Levaditi, C., P. Harvier, and S. Nicolau, 1921. SUR LA PRÉSENCE, DANS LA SALIVE DES SUJETS

SAINS, D'UN VIRUS PRODUISANT LA KÉRATO-CONJONCTIVITE ET L'ENCÉPHALITE CHEZ LE LAPIN [On the presence, in the saliva of healthy subjects, of a virus which produces keratoconjunctivitis and encephalitis in the rabbit]. *Compt. rend. de la Soc. de Biol. (Paris)*, 84 (16): 817-818.

Fresh saliva of apparently healthy subjects was inoculated into the scarified cornea of rabbits; after a 24-48 hour period, a severe keratitis accompanied by conjunctivitis similar to that caused by inoculations of encephalitis virus, occurred in 7 of 12 rabbits inoculated. Examination of one rabbit that died 9 days after inoculation revealed cerebral lesions similar to those resulting from encephalitis virus infection. Recovery from the saliva virus did not result in immunity to the encephalitis virus. Salivary microbes grown on ordinary aerobic and anaerobic media did not appear to play an important part in salivary keratoconjunctivitis.

The keratogenic salivary virus appeared to be associated with the cellular element (stratified squamous epithelia of the mouth) in saliva. The sediment in centrifuged saliva was found to be richer in virus than the supernatant fluid. Virulent saliva filtered through a Chamberland I (un-glazed porcelain) filter caused a less severe keratitis than that caused by non-filtered saliva or by the sediment of centrifugation.

Levaditi, C., P. Harvier, and S. Nicolau, 1921a. TRANSMISSION EXPÉRIMENTALE DU VIRUS DE L'ENCÉPHALITE DE LA MÈRE AU FOETUS [The experimental transmission of encephalitis virus from mother to fetus]. *Compt. rend. de la Soc. de Biol. (Paris)*, 84 (19): 957-959; discussion, p. 958-959.

A healthy infant can contract encephalitis from bucco-nasal secretions or from milk of the infected mother. There are two types of virus—the encephalitis virus and the salivary encephalitogenic virus (virus of carriers).

Levenson-Gantman, A. S., 1932. ACIDOPHIL'NYI BAT'SIL V INTAKTNYKH RTAKH I EGO SVIAZ' S ETIOLOGIEI I PATOGENESOM KARIESA [The acidophilic bacillus in the mouth with intact teeth and its relationship to the etiology and pathology of dental caries]. *Stomatologiya*, 10 (2-3): 13-16.

The presence of *Bacillus acidophilus* [Lactobacillus acidophilus] in the saliva of man was studied in individuals with and without dental caries. Acidulated broth (pH 4.6 to 4.75) was seeded with saliva; incubated for 7 days, then reseeded on agar and the cultures isolated on Hibler medium.

Salivary samples from 82% of mouths without any dental caries produced the growth of *B. acidophilus*.

The author concludes that there is no relationship between the presence of the acidophilic bacillus in the mouth and the appearance of dental caries.

Levin, S. L., 1932. OVZAIMOOTNOSHENIĖ AKH MEZH DU SILOI USLOVNYKH RAZDRAZHITELEI I VELICHINOI BEZUSLOVNYKH REFLEKSOV [On the correlation between the strength of conditioned stimulation and the value of unconditioned reflexes]. *Ark. bio. Nauk, Leningrad*, 31 (5-6): 376-385.

Study of the influence of the amount of reinforcement on the value of the conditioned reflex

in a child showed a regular predominant response to the strongest stimulant, regardless the amount of reinforcement use. Results demonstrated that the value of the conditioned salivary reflex is a function of the strength of the conditioned stimulant. The response to the strongest conditioned stimulation is stable; only a slight change occurred after doubling the reinforcement and hardly any after decreasing it to a minimum; the response to the weakest conditioned stimulant is more labile.

Levin, S. L., 1939. ASIMMETRIĖ SLĖNNOSTI DELENIĖ PRI PORAZHENiĖ AKH TSENTRAL'NOI I PERIFERICHESKOI NERVNOI SISTEMY [Asymmetry of salivary secretion in affections of the central and peripheral nervous system]. *Fiziol. Zhur. SSSR*, 27 (3): 346-349.

A study of conditioned secretory reflexes in hemiplegic children revealed an asymmetry in the secretion of the parotid glands. The secretory reflex manifested itself much stronger and quicker on the side of the paralysis, than on the unaffected side. A similar relationship was found in the unconditioned reflex salivation. A detailed study of the asymmetry in parotid secretion in about 200 cases of hemiparesis or paralysis and in cases of peripheral paralysis of the facial nerve, was then undertaken and carried out during 6 years. Results were compared to those found on the healthy side. Stimulation was produced either by means of hard or liquid food (10 gm. of bread, cheese, chocolate, sour cranberry, divided into 15 equal parts, given every 12 sec. during 3 min., or 20% glucose solution, 2% standard cranberry extract, and, especially, 0.5% citric acid, introduced at 2 cc. every 12 sec. during 3 min.), or by means of subcutaneous pilocarpine injection (0.3 to 0.8 cc. of a 1% solution). Mastication took place on alternating sides, at 8 to 10 min. intervals. The liquids were introduced by means of an irrigating cap applied to the portion above Stensen's duct, on the desired side.

Results in 75% of the cases showed an increase in salivary secretion on the side of the cerebral paralysis or paresia. This symptom, termed the "salivatory phenomenon," can always be observed in cases where unilateral hemiplegia is accompanied by a central paresis of the facial and sublingual nerves on the same side. It is observed after any type of stimulation, the secretion being always greater on the affected side. The asymmetry in the secretion rate of both sides is greater than has ever been observed in normal cases. Examination of the "salivatory phenomenon" in cases of organic central lesions revealed moreover a divergence in the qualitative composition of the salivas, which will be described in a later article. Because of its permanence and the simplicity of its determination, this symptom may serve in the study of vegetative asymmetry.

Peripheral affection of the facial nerve was accompanied, in all but one case, by diminished secretion on the ipsilateral side. An improvement in the physical condition is accompanied by an increase in the ipsilateral salivary secretion.

The pilocarpine tests showed, in the majority of cases, a greatly decreased secretion on the side of the peripheral lesion as compared to that of the healthy side. The mechanism responsible for these phenomena is further discussed.

Levin, S. L., 1946. EVOLIUTSIONNAIA TEORIIA REGULATSII DEIATEL'NOSTI SLIUNNYKH ZHELEZ I EE KLINICHESKOE ZNACHENIE PRI TSEREBRAL'NYKH PORAZHENiiAKH [The evolution theory of the regulation of salivary gland activity and its clinical value in cerebral lesions]. *Fiziol. Zhur. SSSR*, 32 (2): 201-205.

Both types of regulation of the salivary system (nervous and humoral) were studied in patients with a cerebral trauma or tumor. The oral mucosa was irrigated with 30 cc. of a 0.5% solution of citric acid during 3 min., and 0.5 cc. of a 1% solution of pilocarpine was injected. The saliva was collected from the parotid gland during the irrigation and the 3 following minutes according to the method described earlier (Levin, 1935).

The results confirmed the rule that injuries in the medulla and in the brain depress or stop unconditioned (reflectory) ipsilateral salivation; the conditioned (humoral) salivation produced through pilocarpine is more stimulated on the ipsilateral side than on the other. The author gives the following conclusions:

1. The regulation of salivary gland activity is effected at different levels of the central nervous system, not only at the level of the reflex arc, but also in the region of the oral part of the brain stem and of the cerebral hemispheres.

2. The exclusion of one of these regulating centres results in disturbed secretory activity which takes the form of either the elimination or the intensification of the secretory reflex and the disinhibition of the automatic activity of the glands themselves, which is manifested by the phenomena of physiological "denervation" and the assymetry of the secretory reflexes.

3. The symptom of physiological "denervation" (of the peripheral type) occurs in cases of rupture of the unconditioned reflex arc and lesion of the brain stem. "Denervation" of the central (hemispheric) type is characterized by disinhibition of both the unconditioned reflex arc and of the glandular apparatus itself.

4. Assymetry of salivation in different combinations which are, however, characteristic of each given level, is observed in lesions of any of the above mentioned levels of the brain.

5. Lesions of the glandular tissue itself cause either the elimination or a decrease of the secretory reflex, both in response to the unconditioned and the pilocarpine stimuli.

The results are considered to confirm earlier findings of Orbeli (1938).

Levin, S. L., 1947. PILOKARPINOVAIA SEKRETSIIA SLIUNNYKH ZHELEZ CHELOVEKA PRI RAZLICHNYKH PORAZHENiiAKH GOLOVNOGO MOZGA [Pilocarpine salivary secretion in man after various cerebral injuries]. *Biull. eksper. Biol. Med., Moskva*, 23 (3): 194-196.

Changes in parotid salivation, noted in experimental animals after section of the tympanic nerve, were found in human subjects having intracranial traumatic injuries in the taste-secretory reflex arc. Saliva flow was measured from the capped duct of the parotid gland stimulated either by unilateral irrigation of the oral mucosa with 0.5% citric acid for 3 minutes or subcutaneous injection of 0.5 cc. of 1% pilocarpine. Traumatic injury to the left, small superficial petrosal nerve caused the denervated left parotid gland to secrete a much larger amount of pilocarpine saliva

than the right, normal gland; salivation in response to the acid or to food was absent from the left parotid but present from the normal gland. Analogous results were observed in 10 cases of injury to the central part of the reflex arc in vascular and tumor affections. Cerebral affections in 250 cases showed increased reflex and pilocarpine salivation heterolateral to the injury. Neural changes in the saliva reflex arc, and diagnostic use of alterations in salivary flow are discussed.

Levin, S. L., and A. I. Klierin, 1947a. NOVYI VARIANT PRIBORA DLIIA SOBIRANIIA SEKRETA SLIUNNYKH ZHELEZ CHELOVEKA [A new version of the device for collecting salivary secretion in man]. *Biull. eksper. Biol. Med., Moskva*, 24 (1): 490-491.

Description is given of a new salivary-duct cap for collecting saliva in man. The improved form of the Lashley-Krasnogorskii cap is made of aviation glass instead of silver.

Levin, S. L., 1948. ATROPIN KAK STIMULIATOR SLIUNOOTDELENIIA [Atropine as a stimulator of salivary secretion]. *Biull. eksper. Biol. Med., Moskva*, 4: 280-283. *Abstr.: Sovet. med. refer. Obozrenie, Fiziol.*, 1949 (3): 19.

Salivary secretion was studied in patients with various injuries to the innervation of the parotid gland: central type of denervation (pathological processes in the cerebral hemispheres), privation of peripheral parasympathetic innervation (rupture of the temporal bone pyramid and disrapture of the effector part of the unconditioned reflex arch), privation of the parasympathetic and sympathetic innervation (added operation on the superior cervical ganglia). On the side of hemiplegia (central type of denervation) an increase in reflex and pilocarpine salivation is observed; simultaneous injection of atropine and pilocarpine reduces the lag period and increases the salivation. The combination of atropine and pilocarpine induces an increased local glandular reaction also in the peripheral type of denervation; the combination of atropine and pilocarpine results in a sharp decrease of salivary secretion in the normal gland. Tests in completely denervated glands have shown that atropine combined with pilocarpine elicits the strongest salivary stimulation. Thus, atropine, which is a typical inhibitor of pilocarpine secretion, becomes in certain determined cases its stimulator.

Levin, S. L., 1948a. O SHESTI UROVNIĖAKH REGULATSII FUNKTSII SLIUNNYKH ZHELEZ I IKH KLINIKO-PHYSIOLOGICHESKOM ZNACHENII [On the six levels of functional regulation of the salivary glands and their clinico-physiological importance]. *Voprosy Neirokhir.*, 12 (2): 53-56. *Abstract: Sovet. med. refer. Obozrenie*, 1950 (6): 88.

Systematic study of saliva secretion in neurological patients indicates the presence of six levels of salivary regulation. The cortical level, apparent in traumatic or inflammatory damages of the cortex, is characterized by an increase in pilocarpine-stimulated saliva flow on the affected side. The midbrain level, seen in subjects who have recovered from epidemic encephalitis, is marked by an increase in spontaneous salivation which is inhibited by atropine. The bulbar level, occurring after lateral damage to the brain stem, is indicated by a sharp decrease in reflex salivation

and an increase in pilocarpine-salivation on the affected side. Rupture of the unconditioned reflex arc is characterized by changes in rate of parotid reflex salivary secretion. Desympathization of the salivary gland is marked by depression of reflex secretion and increase in pilocarpine salivation. Local automatism, appearing in a completely denervated salivary gland, is characterized by abundant salivation after simultaneous injection of pilocarpine and a small amount of atropine.

Levin, S. L., 1948b. BEZUSLOVNYE REFLEKSY SLIUNNYKH ZHELEZ PRI TRAVMATICHESKIKH POVREZHDENIYAKH GOLOVNOGO MOZGA. [Unconditioned reflexes of the salivary glands in traumatic injuries of the brain]. *Fiziol. Zhur.*, 34 (2): 165-173.

The salivary secretion of 206 hospital cases with traumatic injuries of the brain was studied. Krasnogorskii's capsula was applied to Stensen's duct and the oral mucosa irrigated with a 0.5% citric acid solution (30 ml. during 3 min.). The secretion was measured during and 3 min. after the irrigation. The results obtained lead to the following conclusions:

Traumatic wounds with destruction of the brain substance produce a) a sharp depression in secretion immediately after the injury and brain operation, which diminishes gradually as the patient's recovery progresses, b) a secretory asymmetry, due to an ipsilateral depression and a contralateral stimulation of the unconditioned salivary reflex (i.e. on the side of the paralysis).

This asymmetry is particularly constant in the cases of injury of the motor and pre-motor zone of the brain, especially of the opercular region.

Brain injuries followed by fits of "focal" epilepsy produce an increase of secretion ipsilateral to the injury (i.e. a perversion of the asymmetry).

Complications subsequent to brain injuries (protrusion, meningoencephalitis, abscesses) lead to redoubling of the secretory asymmetry. The graver the complication, the sharper the secretory depression on the side of the injury; the secretion may even completely disappear, first on the ipsilateral side and later also on the contralateral.

On recuperation from the trauma the unconditioned secretory reflexes are restored to normal and the asymmetry disappears. Consequently, the author considers that the study of salivary reflexes provides an objective and accurate indication of the course taken by the healing process after a brain trauma, of the emergence and importance of a complication and of the results of operational intervention, as well as of the conditions of the body as a whole.

Levin, S. L., 1949. SALIVATORNYE FENOMENY V NEIROONKOLOGICHESKOI KLINIKE [Salivary phenomena in the neuro-oncological clinic]. *Voprosy Neirokhir.*, 13 (4): 53-57.

A review is presented of ten years of experience in salivary reflexes in over 400 patients of the Neuro-oncological Clinic. Systematic investigation has shown that the study of these reflexes may be of substantial assistance in the determination of the location and level of a pathological focus, (supratentorial or subtentorial),

of the character of the disease (tumor, inflammatory, or vascular process), and of the dynamics of the process (progress of the disease or functional restoration). The method consisted in a correlation between reflex salivation, regulated by the bulbar salivary center, and pilocarpine, humoral salivation regulated by the glandular apparatus itself. Reflex salivation was elicited by irrigation with 10 cc. of 0.5 to 2% citric acid per minute, during 3 minutes (by means of Krasnogorskii's cap applied to the parotid duct); such salivation measured during 6 minutes normally shows a secretion rate varying from 4 to 6 cc. Automatic salivation was elicited by 0.5 cc. of 1% pilocarpine and measured every 5 minutes during 1 hour. Changes in salivary flow and composition, occurring with the various pathological conditions, are discussed in detail.

Levine, Milton G., and R. E. Hoyt, 1946. PERSISTENCE OF PENICILLIN IN SALIVA AFTER LOCAL ORAL APPLICATION. *Jour. Amer. Pharm. Assoc.*, 35 (11): 346-348.

A study was made of the persistence of penicillin in saliva after local applications of the drug in chewing gum (400 units total), in a mouthwash (200, 5,000, and 10,000 units/cc.), and in a flavored paraffin base (10,000, 20,000, and 40,000 units total). The persistence of the drug for periods up to 4 hours was found to depend on the amount of penicillin used regardless of the preparation.

Levine, Philip, and E. M. Katzin, 1941. PATHOGENESIS OF ERYTHROBLASTOSIS FETALIS: ABSENCE OF THE Rh FACTOR FROM SALIVA. *Proc. Soc. exper. Biol. Med.*, 48 (1): 126-129.

A method, suitable for the detection of the Rh factor in tissue cells and body fluids, was developed and failed to demonstrate the factor in the salivas of 63 individuals (31 of whom were known to be Rh Rh+). From the absence of the factor in the salivas, as well as from sperm cells, seminal fluids, etc., it may be assumed that the Rh factor is limited to erythrocytes only, but further study is warranted.

Levy, B., and J. L. T. Appleton, 1941. EFFECT OF SALIVA ON CAPILLARY PERMEABILITY. *Jour. dent. Res.*, 20 (3): 281.

Intradermal injection of 0.2 cc. of stimulated whole human saliva into previously depilatorized abdominal skin of the rabbit increased capillary permeability at the injection site within 5 minutes. Similar, control injections of physiologic saline, distilled water, Ringer's solution, and 0.1% horse serum gave negative results; a turpentine control increased permeability. A study of salivary fractions showed centrifuged, filtered, dialyzed, heated (80° and 100°C, 5 min.), ether extracted, and electrophorized (negative pole greater) salivas increased capillary permeability; dialysate, distillate, and residue of saliva did not. The responsible salivary factor is considered to be neither living bacteria, salts, proteolytic enzymes, proteins, ether soluble fraction, pH, nor hypotonicity. The active agent does tend to concentrate at the negative pole. [From author's abstract.]

Levy, B. M., and J. L. T. Appleton, 1942. EFFECT OF SALIVA ON CAPILLARY PERMEABILITY. *Jour. dental Res.*, 21 (6): 505-508.

Changes in capillary permeability after intradermal injections of saliva were demonstrated in rabbits by means of a vital stain.

0.02 cc. of centrifuged, human saliva was injected into the skin of a rabbit's abdomen and 7 cc. of 1% trypan blue were injected intravenously. A blue "blotch" appeared at the site of the salivary injection, denoting the local increase of capillary permeability.

A series of samples of modified saliva were injected, consisting of (1) filtered, bacteria-free saliva; (2) dialyzed, therefore relatively salt-free saliva; (3) saliva heated at 80° C. for 10 minutes, inhibiting the enzyme system; (4) saliva heated at 100° C. for 10 minutes, denaturing the proteins; (5) saliva free of ether soluble substances, and (6) mucin-free saliva (parotid saliva). Trypan blue was administered intravenously after each injection. In all cases, the reaction was positive and a blue blotch appeared at the site of the injection, showing an increase in capillary permeability.

A similarity was noted between leukotaxine, a substance isolated from inflammatory exudate, which increases capillary permeability and attracts leukocytes, and the permeability-increasing factor of saliva. Both factors are thermostable at 100° C. and insoluble in ether. A crystalline material obtained from saliva by the method employed for the isolation of leukotaxine, was biologically identical with leukotaxine, but the crystals of both substances differed microscopically.

Lewis, Alexander M., and L. W. Burket, 1948. THE EFFECT OF SUSTAINED SALIVARY SULFATHIAZOLE LEVELS ON THE ORAL BACTERIAL POPULATION. *Oral Surg.*, 1 (12): 1092-1097.

The effect of chewing sulfathiazole gum wafers on the bacterial count of saliva, the duration of the effect, and the frequency of dosage necessary to sustain effective salivary sulfathiazole levels was determined in 50 healthy subjects. There was a consistent drop in the number of oral bacteria on chewing the medicated gum for 60 min. The lowest bacterial count occurred after chewing had been stopped for 30 min. The depression of streptococcal organisms appeared to be slightly greater than the depression of the total bacterial flora. The salivary sulfathiazole levels reached a maximum after chewing the medicated gum for 60 min., and fell to traces within 20 min. To sustain effective salivary sulfathiazole levels it is suggested that medicated gum be chewed for 1/2 hour, discarded, and the process repeated after a 1/2 hour interval.

Lewis, Howard B., and Helen Updegraff, 1922. THE ORGANIC CONSTITUENTS OF THE SALIVA. *Proc. Soc. exper. Biol. Med.*, 20 (3): 168-169.

"We have applied the recent method of Benedict for the determination of uric acid in blood to the filtrate obtained from saliva by a slight modification of the Folin-Wu tungstic acid precipitation method. Fifty-one samples of saliva from thirty healthy men showed maximum and minimum contents of uric acid of 2.9 and 0.6 mgs. per 100 cc. of saliva, while fifteen samples from ten women showed similar variations from 2.3 mg. to 0.7 mg. In more than fifty per cent of the salivas obtained from men, the uric acid content fell within a range of 1.6 to 2.1 mgs., while in the case of the women the values ranged from 1.05 to 1.15 mgs. in more than fifty per cent of the

salivas examined. Twenty-two samples collected at intervals over a period of four months from the same woman showed variations of from 1.5 mg. to 0.7 mg. Samples of saliva and blood were collected simultaneously and analyzed for uric acid. Salivary uric acid was much lower than the uric acid of the blood (approximately thirty per cent of the uric acid of the blood in most cases)...."

The salivary glands did not appear to be readily permeable to glucose of the blood. Two individuals were given 100 g. of glucose enterally; the blood sugar was increased by 50% after approximately one and one-half hours, yet no glucose could be determined in the saliva.

Lewis, John B., and A. Hartman, 1950. A METHOD OF COUNTING ORAL BACTERIA. *Oral Surg.*, 3 (9): 1200-1205.

Some of the errors found in various methods of counting bacteria in saliva are discussed. A description is given of a method of counting oral bacteria which shows a standard error of 4.23 per cent and a standard deviation of 13.36 per cent. Counts of 20,000 to 90,000 bacteria per cc. gave the greatest accuracy. No significant variation in count was noted between 2 workers.

Lewis, John B. and A. J. Singer, 1950a. SALIVARY BACTERIA. I. A STUDY OF TWO METHODS FOR COUNTING *LACTOBACILLUS ACIDOPHILUS* IN SALIVA. *Oral Surg.*, 3 (8): 1078-1084.

A comparison of the Lewis (cf. Lewis, 1950.) and the Hadley (cf. Hadley, 1933.) methods of counting *Lactobacillus acidophilus* in saliva indicates that the Lewis method is the more accurate and reproducible of the two. In both methods there was less than 1 per cent variation in counts of organisms not *L. acidophilus*, and variations due to individual workers were within the reported deviations.

The length of time elapsing between the collection of the saliva specimens and plating the dilutions has a direct effect on the number of *L. acidophilus* present and on the hydrogen-ion concentration, allowing both to vary erratically and unpredictably, and not in parallel with each other.

Lilienthal, B., 1955. BUFFERING SYSTEMS IN THE MOUTH. *Oral Surg. Oral Med. Oral Pathol.*, 8 (8): 828-841.

Previous findings on buffer systems in saliva, salivary sediment and dental plaque are reviewed and discussed. Analyses of 5-minute samples of activated saliva from 67 institutional children showed a highly significant direct relationship between the volume of samples and their buffering effect. Analysis of paraffin-stimulated samples of saliva collected from 15 other children from the same group, before and after a 20-minute meal showed no consistent difference in buffering effect between samples; initial and final 5-minute samples of paraffin-stimulated saliva collected during a similar 20-minute period likewise showed no appreciable change in buffering properties. Such changes noted during the test period paralleled changes in salivary HCO_3 concentration. No consistent relation was found between the volume of the sample and the salivary concentrations of HCO_3 , Na, and K. Results of a correlation between the salivary buffering effect and dental caries incidence in 65 children are presented

and discussed. Freezing and storage at -18°C were found to have negligible effects on the buffering properties and mucoid content of saliva in preliminary tests.

Lilienthal, B., 1955a. AN ANALYSIS OF THE BUFFER SYSTEM IN SALIVA. *Jour. Dental Res.*, 34 (4): 516-530.

The buffer capacity of the paraffin-stimulated salivas of 30 persons were determined by titration with lactic acid under oil before and after removal of the salivary bicarbonate system. Details are given concerning the method of bicarbonate-carbonate removal which is effected by bubbling CO_2 -free air through diluted saliva adjusted below pH 5.0. Results show that variation in the buffer capacity of the individual salivas is due primarily to variation in the salivary bicarbonate system. Further titration on removal of the bicarbonate and readjustment of the pH with NaOH showed the salivary phosphate and other possible systems to remain reasonable constant. Further tests in 36 subjects using HCl and $\text{Ba}(\text{OH})_2$ instead of lactic acid and NaOH in the described titration method, as well as gasometric analyses confirmed these results. The bicarbonate system provided 64 to 84% of the salivary buffer capacity. Dialyses of paraffin-stimulated saliva in a cellophane bag against distilled water for 4 hours at 4°C . removed all phosphate and 90% of the bicarbonate. The buffer capacity was then found to be greatly reduced, and became the same as that for distilled water on removal of the remaining bicarbonate. These observations show the absence of any significant buffering activity in the bacteria mucoids and proteins remaining in the dialyzed sample. Tests of salivary mucoid, precipitated from saliva by citric acid (Knox and Still, 1953,) were made before and after removal of carbonate. Results show no buffering activity by the mucoid between pH 7.0 and 4.0. Tests of the sediment from centrifuged paraffin-stimulated saliva showed its buffering action to be due to variable amounts of adsorbed bicarbonate present in the bacteria. Dentobacterial plaque material did not show the presence of bicarbonate; buffering action here apparently is due to plaque organisms. Incubation of stimulated saliva at 37°C for 24 hours caused an increase in buffer capacity due to increases in bicarbonate, amines, and, to a small extent, ammonia production; no change occurred in the phosphate concentration of the saliva. Similar studies of 32 samples of resting saliva show its bicarbonate system to contribute 30 to 85% of the total salivary buffering; in 85% of the samples this system held 40 to 70% of the buffer power. Of the various salivary components tested, the only significant buffers are bicarbonate and phosphate, with the bicarbonate system being the principal contributor.

Lilienthal, B., 1956. THE EFFECT OF FLUORIDE ON ACID FORMATION BY SALIVARY SEDIMENT. *Jour. dent. Res.*, 35 (2): 197-204.

A study was made of the effect of various concentrations of the fluoride ion on acid production by oral bacteria, obtained by centrifugation of paraffin-stimulated saliva collected about 2 hours after a meal. The rate of acid formation from sucrose and from glucose was estimated by manometric methods. Results showed

that a 0.01 M concentration of sucrose permitted maximum acid formation in a salivary sediment-glucose mixture incubated at 37°C . A series of fluoride concentrations, tested with 0.01 M sucrose and with 0.01 M glucose as substrates, showed concentrations of 0.5 and 1.0 ppm F^- to have a slight stimulatory effect in acid production; addition of 32 ppm F^- produced a 10 to 30% decrease in acid production after 20 minutes incubation; marked inhibition (50%) occurred in the presence of 160 ppm F^- .

Study of the reversal and enhancement of fluoride inhibition of acid formation showed that addition of sufficient calcium ions reversed the inhibitory effect of fluoride, addition of Mg^{++} , of Mn^{++} , and of PO_4^{---} enhanced the inhibitory effects of fluoride. In the presence of 0.002 M Ca^{++} and 0.005 M PO_4^{---} , 0.5, 1.0, 2.0, 3.0, 19, and 38 ppm F^- had no effect on acid fermentation from sucrose.

Lindaur, V. V., and V. A. Lukach, 1954. METODIKA REGISTRATSII USLOVNOREFLEKTORNOGO SLIŬNOOTDELENIIA U SOBAK [A method of registering the unconditioned reflex salivary secretion in dogs]. *Fiziol. Zhur. SSSR*, 40 (2): 224-226.

Description is given of an electrical drop register for salivary secretion representing a further improvement on the apparatus originally designed by E. A. Ganike and improved by P. S. Kupalov.

Linde, P., 1932. DER ÜBERGANG DES ÄTHYLALKOHOLS IN DEN PAROTISSPEICHEL BEIM MENSCHEN [The passage of ethyl alcohol in the parotid saliva in man]. *Naunyn-Schmiedeberg's Arch. exper. Pathol und Pharmakol.*, 167 (3-4): 285-291.

In a study of salivary excretion of ingested ethyl alcohol the parotid gland of healthy subjects was cannulated and the saliva collected under sterile conditions. The test subjects ingested alcohol, usually on a fasting stomach, in amounts varying from 0.35 to 0.70 mg. per kg. body weight. Salivation was induced by application of an acetic acid solution to the tongue and simultaneous determinations were made the alcoholic content of blood from the finger tip and of the saliva. Results showed the alcoholic content of the saliva to be usually higher than that of the blood, the concentration in the saliva usually corresponding to that in the blood plasma.

Lipner, Harry J. 1947. PHYSIOLOGICAL CONSIDERATIONS OF THE RELATIVE SPECIFICITY OF DENTAL CARIES IN MAN. *Jour. dent. Res.*, 26 (4): 319-325.

A short review is presented on salivary enzyme studies which indicate that the presence of ptyalin in human saliva is one of the chief causes of dental caries in man.

Lisanti, Vincent F., 1950. HYALURONIDASE ACTIVITY IN HUMAN SALIVA. *Jour. dental Res.* 29 (3): 392-395.

Experiments on human saliva were made to determine the presence of hyaluronidase activity and its variation from person to person.

An initial test for hyaluronidase activity was run on the saliva of 8 persons by the viscosimetric method. 10 cc. were collected from each subject within a 90-minute period. The saliva was centrifuged (45 min. at 3500 rpm.), and

the supernatant liquid dialyzed at 4° C. for at least 36 hours. The pyridine method of Hadidian and Pirie was used in preparing the hyaluronic acid substrate. 2 cc. of substrate solution (containing phosphate buffer and NaCl) were added to the dialyzed saliva, the mixture was transferred to an Ostwald viscosimetric tube (25° C.), and measurements of viscosity were taken at regular intervals, for 1 to 6 hours. To determine the initial viscosity, 2 cc. of hyaluronic acid substrate were combined with 2 cc. of distilled water and checks at 2-hour and 4-hour intervals were made to ascertain that the substrate itself did not change in viscosity.

Five of the eight saliva samples produced a reduction of hyaluronic acid viscosity. This investigation was repeated with 64 persons (3 to 34 years of age) to determine a possible relationship between hyaluronidase activity and dental disease. The changes in viscosity during the first 45 minutes of the reaction were accepted as a measure of hyaluronidase activity. The difference in seconds between the flow time of the fresh saliva-substrate mixture and that 45 minutes after the mixing of the saliva substrate, or the "viscosity drop," expresses the hyaluronidase activity.

Findings showed, in 75% of the 64 subjects, that hyaluronidase activity was present, the viscosity drop ranging from 1.0 to 14.5 seconds. It was noted that there was no periodontal disease in the 16 subjects which had no hyaluronidase activity. A correlation of hyaluronidase activity of saliva with number of carious teeth was + 0.442, which the author notes as significant at the 1% level.

Lisanti, Vincent F., and Inga Mahler, 1952. PRELIMINARY FINDINGS OF HYALURONIDASE PRODUCING MICROORGANISMS FROM HUMAN SALIVA. *Bacteriol. Proc.*, 1952 : 129-130.

"In 1950 Lisanti demonstrated hyaluronidase activity in human saliva. The activity varied with numbers of carious teeth at a 1 per cent level. The investigation was extended to include larger numbers of cases, and to determine whether the hyaluronidase activity originated from bacterial sources. Morning samples of saliva were tested viscosimetrically at 25° C. Hyaluronidase activity was expressed as viscosity loss of substrate in seconds after 45 minutes of incubation at 25° C. In some instances, saliva was obtained directly from the gland. Only 9 subjects out of 200 showed no salivary hyaluronidase activity. The remaining cases ranged from .02 per cent to 80 per cent of activity. No enzyme activity could be found in glandular saliva secretions. It was observed that the saliva of patients who reported upper respiratory infections or periodontal disturbances at the time of the investigation showed consistently high hyaluronidase activity. Hyaluronidase producing microorganisms were detected by plating suitably diluted portions of saliva on 5 per cent sucrose agar plates to which 1 per cent 2, 3, 5 triphenyl tetrazolium chloride had been added. Individual colonies were picked and viscosimetrically tested for enzyme activity after 17 hours of growth in veal [infusion] broth. Two types of hyaluronidase producing bacteria were recovered from saliva. In the majority of cases an alpha hemolytic streptococcus identified as *Streptococcus mitis* was found to secrete large amounts of enzyme. In a few instances, hyaluronidase

activity was due to the presence of *Micrococcus pyogenes* var. *aureus*." (Complete paper.)

Lisanti, V. F., and I. R. Mahler, 1952a. THE SIGNIFICANCE OF THE VARIATION OF HYALURONIDASE ACTIVITY IN HUMAN SALIVA. *Jour. Dental Res.*, 31 (4): 468.

"The presence of certain oral diseases has been shown to elevate the hyaluronidase activity of human saliva. In order to evaluate the significance of this elevation, titers for this enzyme have been determined on 173 subjects from 3 to 34 years of age. Good correlation was obtained with the number of decayed teeth significant to the 1 per cent level. Periodontal lesions, whether caries were present or not, caused an increase in hyaluronidase activity in 17 cases examined. Sixty subjects having colds or upper respiratory involvements demonstrated 2.5 times the activity of the 95 controls. Thirty of these subjects were tested before and during colds or upper respiratory disturbances. During the active symptomatic phase of these disturbances, the enzyme activity was 3.2 times the level when free of disease. Statistical evaluation of the data indicates the probability that findings are extremely significant below the 1 per cent level." (Author's abstract)

Lisanti, V. F., and H. H. Chauncey, 1955. WHOLE SALIVA ENZYMIC ACTIVITIES AND CHARACTERISTIC PATTERNS RELATED TO ORAL CONDITIONS. *Jour. Dental Res.*, 34 (5): 708.

A significant relationship exists between oral disease processes and certain whole-saliva hydrolytic enzymes. Hyaluronidase, cholinesterase β -glucuronidase, lipase were found to be of diagnostic value. Characteristic salivary enzyme patterns were found in a mixed male population having the following categories of oral conditions: normal, dental caries, periodontal disease, dental caries plus periodontal disease, and edentulous. It was possible to select the caries group in 70 to 80% of the cases, the periodontal group 80 to 90%, and the mixed group 60 to 70%. (From author's abstract)

Lisanti, V. F., and H. H. Chauncey, 1955a. SALIVARY ACID AND ALKALINE PHOSPHATASE AS PREDICTORS OF ORAL CONDITIONS. *Jour. Dental Res.*, 34 (5): 760-761.

"Acid and alkaline phosphatase activity were determined in the whole saliva of 92 individuals. The population consisted of 5 groups: "normal," dental caries only, periodontal disease only, caries and periodontal disease, and edentulous. Statistical comparison of the groups revealed no significant difference in acid phosphatase activity between the groups except for the edentulous patients. The mean enzyme titer for the edentulous group was significantly higher than those exhibited by the 4 other groups. The confidence levels of differences ranged from 5 to 10%. In a normally distributed population it was not possible to differentiate oral condition, except for the edentulous individuals. Only when more extreme values were included (both high and low) was it possible to differentiate caries free from rampant caries cases 36% of the time. Although the acid and alkaline phosphatase values had a correlation r equal to 0.55 with a level of confidence of 1%, the alkaline phosphatase mean

values did not differ significantly among any of the 5 groups." (Author's abstract)

Lisbonne, Marcel, 1910. SUR L'INVERTINE DE LA SALIVE [On invertine of saliva]. Compt. rend. Soc. Biol. (Paris), 68: 983-985.

The origin and action of salivary invertine were studied. Observations over various periods of time showed the quantity of sugar inverted to saccharose in a human mixed-saliva and sugar (in a fluorine medium) to range from 2% to 16.8% (12 hours). A series of four tests using filtered salivas indicated the invertine content of saliva to be microbial in origin.

Lisbonne, Marcel, 1911. SUR UNE CONDITION DE MILIEU NÉCESSAIRE A L'ACTION DE L'AMYLASE SALIVAIRE [On a condition of the medium necessary for the action of salivary amylase]. Compt. rend. de la Soc. de Biol. (Paris), 70 (2): 62-63.

In a previous paper it was stated by the author that human saliva, filtered through a Berkefeld candle and dialyzed through a collodion membrane, retains its power to convert starch. It exhibits, however, no activity on demineralized starch prepared by the method of Wolff and Fernbach (potato starch is treated with HCl, 1:1000, for one hour and then is washed with distilled water until the washings are neutral to methyl orange).

The amylolytic power of dialyzed saliva acting on demineralized starch was restored when certain electrolytes were added to the saliva: phosphates, arsenates, carbonates, citrates, acetates, or oxalates. On the other hand, chlorides, bromides, iodides, sulfates, nitrates, alkaline metals, or alkaline earth metals did not restore its action even after a 24-hour incubation at 40°C.

The primary phosphates were inactive; but very small quantities of secondary phosphates were sufficient to activate the starch and saliva mixture: 1 to 5 mg. for 20 cc. of 3% starch and 0.2 cc. dialyzed saliva. Sodium carbonate and bicarbonate reactivated the enzyme in concentrations of 0.005%. The neutral salts of organic acids exhibited optimum action at a concentration of approximately 0.06%.

The results of the experiments lead the author to conclude that the cause of the inactivity of the dialyzed saliva on this form of starch lies in the lack of an amphoteric substrate. Ptyalin, in the absence of salts which are found in the saliva (i.e., phosphates, carbonates, etc.) is inactive on this type of starch (in which phosphates have been reduced to primary salts), but the addition of dibasic phosphates, or salts of oxalates, etc., reactivate the diastase by the fact that the secondary salts restore to the starch its amphoteric reaction.

Lisbonne, Marcel, 1911a. SUR LE ROLE DES ELECTROLYTES DANS LA SACCHARIFICATION DE L'AMIDON PAR LES AMYLASES SALIVAIRE ET PANCRÉATIQUE [On the role of electrolytes in the saccharification of starch by salivary and pancreatic amylases]. Compt. rend. de la Soc. de Biol. (Paris), 70 (4): 132-134.

Experiments on the action of dialyzed saliva on demineralized starch were continued (cf. Lisbonne, 1911m). Na_2HPO_4 and NaCl were added at the same time to a mixture of dialyzed human

saliva and demineralized starch. The diastatic power expressed in terms of the amount of maltose formed was found to be 30 times as high as that produced by the influence of phosphates alone. Other chlorides, bromides, and iodides exhibited this same activating property when added to dibasic phosphates.

Data are given for experiments on the action of dialyzed pancreatic juice of dog on starch.

Lisbonne, Marcell, 1911b. COAGULATION DE L'AMIDON PAR LA SALIVE ET LE SUC PANCRÉATIQUE [Coagulation of starch by saliva and pancreatic juice]. Compt. rend. de la Soc. de Biol. (Paris), 71 (26): 140-142.

Addition of 0.5 cc. of dialyzed (to remove the amylolytic enzyme) human saliva to 10 cc. of 1% starch solution at 50°C. caused precipitation of all starch in 15-20 minutes. This saliva heated at 80° - 90°C for 15-20 minutes lost its amylo-coagulating power. The coagulated starch could be redissolved by heating but spontaneously precipitated on cooling and was for the most part resistant to diastase. No explanation is found for this coagulation.

Little, Marguerite F., F. Brudevold, and R. Taylor, 1951. THE EFFECT OF AMMONIATED DENTRIFRICES ON THE pH AND ACID PRODUCING CAPACITY OF DENTAL PLAQUES. Jour. Dental Res., 30 (4): 495.

"Preliminary studies of saliva from persons using an ammoniated or nonammoniated dentrifice showed the ammoniated dentrifice to be ineffective in changing the salivary pH and fermentation." (From authors' abstract)

Liubimov, S. P., 1915. VLIĖANIE POVTORNYKH SLIUNNYKH REFLEKSOV NA SOSTAV SLIUNY [The influence of repeated salivary reflexes on the composition of saliva]. Russkii Vrach, 12: 278-279.

Experiments involving repeated stimulation of salivary glands in the dog showed that feedings of equal portions of food at short, uniform intervals produced a decrease in salivary rate of flow to one-half or one-third of its initial value. The salivation rate gradually increased to double or triple of its initial value, however, if unedible, irritating substances as HCl or NaHCO_3 were substituted for the food portions. Viscosity determinations were made of the submaxillary saliva of 3 dogs; measurements were made by the capillary method in drops per second of the saliva, elicited by a 45-second feeding of 4 gm. of rusk powder at 5-minute intervals. Results showed a steady decrease in the viscosity of the saliva secreted in response to repeated food stimulation. Oral stimulation with 10 cc. of 0.25% HCl at 5-minute intervals showed a general increase in salivary viscosity of samples elicited toward the end of the experiment. The amount of salivary viscosity and solid residue were proportional to the salivation rate, decreasing after repeated uniform food stimulation and increasing after similar but non-edible stimulation.

Lodholz, Edward, 1904. ON THE ORIGIN OF POTASSIUM SULFOCYANIDE IN THE SALIVA. Dental Cosmos, 46 (3): 196-198.

Intravenous injection of potassium thiocyanate (0.033 g./kg. of body wt. at 15-minute intervals until death) was administered to dogs. Tests of equal amounts of kidney, liver, and salivary gland

tissue showed the least amount, only a trace, to be present in the salivary glands. Various extracts of salivary glands were used to treat proteins at body temperature in an attempt to produce KCNS. The experiments were conducted over periods of 2 hours to 5 weeks, in the presence or absence of free oxygen, and in acid, alkaline, or neutral conditions without producing potassium thiocyanate.

Loevi, O. and G. Mansfield, 1910. ÜBER DEN WIRKUNGSMODUS DES PHYSOSTIGMINS [On the mode of action of physostigmine]. Naunyn-Schmiedeberg's Arch. exper. Pathol. and Pharmacol., 62 (2-3): 180-185.

The effect is studied of physostigmine on salivary flow from the intact and denervated salivary glands.

Lon, F. W., 1911. PROPHYLACTIC VALUE OF POTASSIUM SULFOCYANATE IN SALIVA. Dental Cosmos, 53 (11): 1269-1276.

A plaque or flat gelatinoid patch, which adheres tenaciously to enamel surfaces and is evolved by lactic acid bacteria, is produceable by in vitro cultivation of bacteria poisoned to a certain extent by carbolic acid or oil of cassia. The plaque is held to be a self-protective development. Potassium thiocyanate stimulates the bacterial growth to the extent that plaques are not formed. Since sterile lamb broth, which produces plaques, contains only minute amounts of saliva and mucin, development of the plaque is not attributable to the presence of the mucin.

Looijen, S. G., and O. Muhlbock, 1952. SEX DIMORPHISM IN THE SALIVARY GLAND OF THE MOUSE. Acta Physiol. Pharmacol. Neerl., 2 (2): 286.

An examination of the submaxillary glands of male and female mice showed the amylase production of these glands in infantile animals to equal that of adult females and that of adult castrated males. Injection of testosterone into females and castrated males resulted in development of secretory tubules of the gland and increase in amylase production. Injection of thyroxin into castrated animals produced similar effects. Estrone, progesterone and desoxycorticosterone had no effect on glandular development or amylase content.

Lorina, Phyllis L., and V. F. Lisanti, 1953. STREPTOCOCCAL BETA GLUCURONIDASE AND HYALURONIDASE. Jour. dent. Res., 32 (5): 664.

A study was made of enzyme production by oral bacteria. The only salivary bacteria found to produce beta glucuronidase were *Streptococcus mitis*. Hyaluronidase-producing microorganisms isolated from saliva were predominantly *Str. mitis* with streptococci of Lancefield groups A and K also present. Fifteen of the 24 strains of *Str. mitis* which were hyaluronidase producers were also found to have beta glucuronidase activity.

Losch, P. K., and D. Weisberger, 1940. HIGH CARIES SUSCEPTIBILITY IN DIMINISHED SALIVATION. Amer. Jour. Orthodont. and Oral Surg., 26 (11): 1102-1104.

A case report is presented of a female suffering from xerostomia and extensive caries from the age of 4 to 12 years. A salivary test showed the volume of paraffin-stimulated saliva to be 1

cc. in 1 hour. It is suggested that the high caries incidence is a result of hypofunction of the salivary glands.

Lothrop, Alfred P., and William J. Gies, 1910. A CHEMICAL STUDY OF SALIVA, IN ITS PROBABLE RELATION TO THE DECAY OF TEETH. Jour. allied [dental] Soc., 5 (4): 262-284, discussion, p. 284-290.

The paper presents a general picture of the physical and chemical properties of saliva, including data on salivary examinations.

Chemical data and data pertaining to the consistency of 82 saliva samples obtained from dentists and of 44 samples obtained from dental students are tabulated (cf. p. 267-268). Results led the authors to conclude that, next to the systemic condition of the individual, "direct external" action of microorganisms is the most important single factor in dental caries.

Lothrop, Alfred P., 1912. A STUDY OF SALIVARY MUCIN. Jour. allied [dent.] Soc., 7 (4): 410-428. Abstract: Biochem. Bull., 2 (5): 180-181, 1912.

The literature concerning the origin and content of mucin in saliva is reviewed. Results of determinations of mucin content in the salivas of oxen and of man are tabulated.

Lourie, Reginald S., 1943. RATE OF SECRETION OF THE PAROTID GLANDS IN NORMAL CHILDREN. A MEASUREMENT OF FUNCTION OF THE AUTONOMIC NERVOUS SYSTEM. Amer. Jour. Dis. Child., 65 (3): 455-479.

A study is presented on the control of the rate of secretion of unstimulated parotid saliva by the autonomic nervous system. A literature review indicated the secretory activity of the parotid gland to be controlled primarily by the parasympathetic nervous system, the sympathetic system having no effect on the rate of secretion. An experiment to explore any primary effect of sympathetic innervation on the rate of parotid secretion was made in three children after determination of their normal rates of parotid secretion. Hypodermic administration of small doses of epinephrine hydrochloride (0.1 cc.) of a 1:1000 solution raised blood pressure and pulse rate and produced mild vasoconstriction but no significant change in the rate of secretion. A larger dose (0.5 cc.) given 15 minutes later produced a definite drop in rate. Clinical study of 2 children hospitalized for obvious sympathetic imbalances showed the parotid secretory rate to remain within normal ranges during periods of unstable pulse rate, etc. An evaluation of the literature on various physiologic and psychologic factors, showed local effects, such as oral lesions, general body conditions, factors related to the nervous system, gastrointestinal conditions, and pharmacologic reactions to affect the secretory rate. A study of the normal rate of unstimulated secretion was made in 51 normal children ranging in age from 3 to 14.

The saliva was collected by sialometer 1-1/2 hours after meals. Results show an extremely high normal rate in the youngest, 3-4 year-old age group, with a mean of 0.74 cc./5 min., which drops rapidly to a mean of 0.15 cc. for the same period in the 6-7 year-old age group. From 7 to 14 years a further, gradual and uneven drop in rate was found which approaches in early puberty that of normal adults: 0.02 to 0.12 cc./5 min.,

average, 0.07 cc./5 min. The curve, incomplete due to inability to measure secretion in children under 3 years of age, appears to represent a function of growth and development, possibly of the midbrain and cortical areas of the brain which function to inhibit the rate of parotid secretion. A parallel between the increase in alpha rhythms in brain waves of children and the drop in parotid secretory activity is noted. It is concluded that there are relationships between the cortex, mid-brain, and bulbar centers for salivary activity. Correlations between rates of salivary secretion and various abnormal states are suggested.

Lowenstein, G. A., and William J. Gies, 1919. STUDIES OF SALIVA IN ITS RELATION TO THE TEETH. I. ON THE NORMAL COMPOSITION OF SALIVA: DOES NORMAL SALIVA CONTAIN URIC ACID (URATE)? *Proc. Soc. exper. Biol. Med.*, 16 (4): 53-54.

The uric acid content of human, as determined by the Folin-Benedict method, averaged 2.10 mg./100 cc. saliva for men and 1.11 mg. for women. It was, in general, not affected by diet, but was influenced by the rate of secretion (no details given). A definite relationship was observed between the uric acid content of saliva and that eliminated simultaneously in the urine.

Lubinski, Herbert, and Carl Prausnitz-Breslau, 1926. LYSSA [Rabies]. *Ergeb. d. Hyg. Bakteriolog. Immunitätsforsch. u. exper. Ther.*, 8: 1-164.

In reviewing the literature on rabies, the author concludes that the saliva of an ostensibly healthy dog may contain virulent rabies virus. An integration of the experiments of previous writers on dog, cat, and goat, showed that saliva may be infectious from 2 to 6 days before outbreak of the disease. In a tabulation of the studies of previous works on the clinical reactions of rabid dogs and their victims, attention is called to the work of Babes (*Traité de la rage*, Paris, 1912), on a case in which a dog showed symptoms of rabies at the time of "bite," only to return to what was apparently normal and later to die of typical rabies. Babes considers this a case of recurrent rabies. Although the virus may not be found in the saliva of the rabid animal, it occurs with considerable regularity in the salivary glands (p. 21-23).

Ludwick, W. E., and L. S. Fosdick, 1950. THE AMMONIA CONTENT OF THE MOUTH. *Jour. Dental Res.*, 29 (1): 38-42.

Determinations were made of the ammonia content of tooth brushings by means of a permittit dentifrice used by 1000 randomly selected naval recruits. The mean ammonia level among the 388 individuals classified as relatively caries-immune was 0.33 mg.; among the 612 caries-susceptible subjects the mean was 0.32 mg.

In a second test of 25 caries-immune cases and a similar group of caries-susceptible cases, ammonia determinations were made of teeth scalings following complete dental prophylaxis, in addition to the permittit determinations of teeth brushings, performed in 5 daily consecutive tests. Daily variations in ammonia content were about 10%. The mean ammonia of the brushings varied from .33 mg. for susceptible cases to .37 mg. for the immune; the total ammonia content (brushings and scalings) varied from .41 to .44 mg. Preliminary investigation indicated that ammonia in saliva, which had

been secreted during the brushings, did not appreciably affect these results. The total ammonia removed from the mouth, almost 0.5 mg., is much higher than is ordinarily found in saliva. No relationship was found between the total ammonia content of the mouth and caries activity.

Ludwick, W. E., L. S. Fosdick, and C. W. Schantz, 1951. EFFECT OF DENTIFRICES ON LACTOBACILLUS COUNTS: ANTIBIOTICS AND ENZYME INHIBITORS. *Jour. Amer. dental Assoc.*, 43 (3): 285-289.

Thirteen dentifrices were administered to 780 individuals (average, 18-1/2 years of age) and their effect in reducing the lactobacillus counts were observed. In general, the tooth powder containing 0.07% penicillin was most effective, followed by paste containing 0.07% penicillin, and paste, with 0.5% streptomycin. The latter two were only about 1/2 as effective as the penicillin powder.

Ludwick, W. E., and L. S. Fosdick, 1951a. THE ROLE OF ANTIBIOTICS AND ENZYME INHIBITORS IN RELATION TO LACTOBACILLUS COUNTS. II. *Jour. dental Res.*, 30 (4): 470.

"The lactobacillus count was adopted as a criteria for measuring the effectiveness of 12 dentifrices modified with an antibiotic or an enzyme inhibitor. Groups of 65 recruits each were selected to test the dentifrices for a 7- to 9-week period. Four other groups served as controls for the study. The dentifrices were modified with aureomycin, chlorinated phenol, chloromycetin, copper chlorophyllin, penicillin or white dye. Comparison of the pretreatment with post-treatment median lactobacillus counts indicate a range of 65 per cent decrease to an increase of 23 per cent, while the control groups ranged from a 66 per cent decrease to a 17 per cent increase." (Complete paper.)

Ludwick, William E., Kenneth Bass, and Philip Jay, 1953. EVALUATION OF ANTIBIOTIC AGENTS IN THE CONTROL OF LACTOBACILLUS COUNTS. *Jour. Amer. dental Assoc.*, 46 (2): 174-178.

No evidence of any effect on lactobacillus counts was observed when 320 male Navy recruits received daily capsules (orally) of procaine penicillin (100,000 units), aureomycin (250 mg.), or a placebo, over a 6-week period. There was no indication of oral sensitivity nor of changes in the rates of occurrence of gingivitis.

Ludwig, Thomas G., and B. G. Bibby, 1954. ACID FORMATION IN THE MOUTH AFTER THE INGESTION OF DIFFERENT CARBOHYDRATE FOODS. *Jour. Dental Res.*, 33 (5): 671.

The production of acids in the dental plaque, after 9 different carbohydrate foods had been eaten, was studied in 5 test subjects. Electro-metric measurements of the plaque pH were confirmed by determination of lactic acid production in the saliva after eating the foods. Fig-containing cookies, toffees, and bread with jam produced the greatest quantities of acid; fried potatoes, ice cream, apples, and sweetened beverages produced relatively smaller quantities. (From author's abstract)

Ludwig, Thomas G., and H. J. V. Goldberg, 1956. THE ANTHRONE METHOD FOR THE DETERMINATION

OF CARBOHYDRATES IN FOODS AND IN ORAL RINSING. Jour. Dental Res., 35 (1): 90-94.

A description is given of an anthrone method for the quantitative estimation of carbohydrates. Tests for accuracy and sensitivity showed solutions containing 2 to 5 mg. glucose/100 could be estimated with an error of $\pm 2\%$. Prior hydrolysis is not required for analysis of di- or polysaccharides; estimation of various sugars showed results to be within $\pm 5\%$ of the theoretical glucose equivalent; the presence of protein did not effect accuracy of the method. Test of oral rinsings after consumption of cola or of apple showed determinations after the cola to have 5% error, and after apple, 10% error.

Ludwig, T. G., and B. G. Bibby, 1957. ACID PRODUCTION FROM DIFFERENT CARBOHYDRATE FOODS IN PLAQUE AND SALIVA. Jour. dent. Res., 36 (1): 56-60.

Measurements were made in 6 subjects of the pH in dental plaque material, and of the lactic acid content of saliva after ingestion of each of 7 solid and 3 liquid carbohydrate foods. The subjects were selected in a preliminary test for low production of acid in plaque material over a one-half hour period following a 2-minute oral rinse with a 20 per cent glucose solution. Determinations of the plaque material of the lingual surfaces of the upper premolar teeth, before breakfast and at 5-minute intervals during the half hour after the glucose rinse, showed a rapid drop from about pH 7 to 5 within 5 minutes, and then a return to normal within 20 to 30 minutes. Ingestion of fig sandwich cookie, toffee, and bread and jam was followed by a less rapid drop in pH which persisted for a longer time than after the glucose rinse. Other foods (fried potatoes, apple, ice cream) and carbonated cola beverage gave rise to little acid. Determinations of the lactic acid content of salivary samples collected after a 4-hour fast and at 50-minute intervals after ingestion of the various carbohydrates showed a direct general relationship between plaque and salivary acid values. Values were highest and remained longest after the fig (22 mg. lactic acid/ml. of saliva collected before eating the fig cookie, increased to 1840 mg./ml. ten minutes after ingestion then dropped to 110 mg./ml. twenty minutes later; etc.). Other carbohydrates caused a relatively high acid concentration of short duration in the saliva.

Ludwig, T. G., and B. G. Bibby 1957a. FURTHER OBSERVATIONS UPON THE CARIES-PRODUCING POTENTIALITIES OF VARIOUS FOODSTUFFS. Jour. dent. Res., 36 (1): 61-67.

In a study of caries-producing capabilities of various foods salivary fermentation tests were made in vitro, using pooled saliva to reduce to a minimum the effects of individual variation in salivary samples. The pooled paraffin-stimulated saliva was refrigerated and then used in 5 ml. portions to determine acid production when incubated at 37°C for four hours with 5 ml. of an emulsion of 3 gm. of a test food in 100 ml. of distilled water. One saliva-food mixture was immediately titrated with N/10 NaOH to pH 8.5 and a similar mixture likewise titrated after incubation, the titration differential representing the acid formed by the salivary fermentation. Means, for each of 20 solid and liquid carbohydrate foods

listed, were calculated from 3 such tests using different salivary pools. The greatest quantity of acid was formed from milk chocolate (2.1 ml. N/10 NaOH), lesser quantities being formed from toffees (1.8 ml.) white bread (1.8 ml.), dates (1.6 ml.) and apple (1.0 ml.). Acid production for beverages were low (1.0-1.2 ml.). The amount of acid formed did not depend solely upon the amount of carbohydrate in the food. Study of other variables in regard to food retention in the mouth is described and discussed.

Luk'inachenko, V. S., 1955. DINAMIKA KARIESA U BOL'NOGO POSLE UDALENIYA PODCHELIUSTNYKH SLIUNNYKH ZHELEZ [The dynamics of caries in a patient after removal of the submaxillary glands]. Stomatologiya, 1: 33-34. Abst.: Sovet. med. refer. Obozrenie, Stomatol., 1956 (8): 21.

After excision of both submaxillary glands in a patient, followed by X-ray therapy, all the teeth became carious in the 4.5 years which followed the operation, despite energetic curative and prophylactic measures.

Lukomsky, S. H., 1927. ZUR CHARAKTERISTIK DER FUNKTION DER PAROTISDRÜSE DES MENSCHEN. ÜBER DIE BEDEUTUNG DES NERVUS SYMPATHICUS FÜR DIE SPEICHELSEKRETION UND ÜBER DIE ACTUELLE REAKTION DES PAROTISSEKRETS [On the characterization of the function of the parotid gland in men. On the significance of the sympathetic nerve for the salivary secretion and on the actual reaction of the parotid secretion]. Arch. klin. Chir., 146: 777-786.

A fistula, occurring in the left parotid in a 23-year male, permitted experiments similar to those conducted in fistulated animals. Whenever the patient ingested food, or was exposed to any stimulation outside the mouth, saliva secreted from the fistula. After severing the auriculo-temporal nerve, salivary secretion was not suspended. After surgery, the parotid gland reacted as usual to pilocarpine: the secretion curve first increased then decreased completely. Stimulation of the oral cavity with biscuit, during pilocarpine stimulation, increased the amount of saliva secreted by the parotid. Removal of the left superior sympathetic ganglion resulted in reduction of both the excitability of the gland and the production of saliva. The results indicate that (1) denervation of the parotid gland does not change the H-ion concentration of the gland; (2) after denervation and pilocarpine stimulation the gland reacts the same way as before the alkaloid injection; and (3) combined pilocarpine and atropine affect the function of the intact parotid gland.

Lundberg, Anders, 1956. SECRETORY POTENTIALS AND SECRETION IN THE SUBLINGUAL GLAND OF THE CAT. Nature, 177 (4519): 1080-1081.

In an investigation of the mechanism of the establishment of the secretory potential over the outer membrane of cells of the sublingual gland in cats, use was made of double barrelled microelectrodes. The resting potential over the outer membrane is about 30 mV, internal negativity. Repetitive stimulation of the chorda tympani showed the secretory potential to be substantially unchanged over a large range of membrane potential. As an equilibrium potential was not apparent, the secretory potential is attributed to

transport of anions to the interior of the cell across the outer membrane.

Further experiments were made with glands perfused with oxygenated saline, containing physiological solutions of Na, P, or Ca chlorides.

A normal amount of secretion and a normal secretory potential over the outer membrane followed activation of the gland. Secretion in response to 1 g. of acetylcholine was about one-fourth of the weight of the gland. On replacement of the chloride ion with the nitrate ion in the perfusion fluid the amount of secretion obtained on injection of 1 g. of acetylcholine fell to 10 to 30% of normal; with 10% chloride in the perfusion

fluid, the secretion was 50-60% of normal, while with 50% chloride the secretion was practically the same as that obtained on return to a perfusion fluid containing 100% chloride. A small potential voltage change over the outer membrane was noted on activation of the nitrate-perfused gland. While the nitrate ion is not toxic to the secretory process, it is suggested that the outer membrane has a limited capacity to transport nitrate ions, explaining the limited secretion of the nitrate-perfused gland. Limited secretion at low chloride concentrations is probably due to depletion of chloride ions in the external medium of the gland cells.

MacDonald, C. Franklin, Jr., and H. C. Smith, 1909. OXYDASE IN SALIVA. Jour. allied [dent.] Soc., 3 (4): 346-352.

Human mixed saliva contains an oxidizing enzyme, distinct from ptyalin, which has properties of both an oxydase and a peroxydase. The substance is a product of the body, probably glandular, metabolism and may be increased in quantity or activity by mastication. The color obtained with a freshly-prepared one percent solution of pyrocatechin is a sufficient test for this salivary enzyme, which is more resistant to heat than ptyalin but more easily destroyed by acids.

MacDonald, C. Franklin, 1912. POTASSIUM SULFOCYANATE VERSUS DIACETIC ACID. Dental Cosmos, 54 (1): 58-59.

Tests were made of an ether extraction method and an aqueous solution method of using ferric chloride to demonstrate the presence of potassium thiocyanate in saliva. The ether extraction method was found not to remove the color at KCNS concentrations of less than 0.0125%. The presence in saliva of diacetic acid which might confuse the color test can be eliminated by a drop of concentrated HCl.

MacGregor, Alexander B., and D. A. Long, 1945. LOCAL SPREAD OF DRUGS IN THE ORAL CAVITY. Lancet (London), 249 (6367): 299-300.

A study was made of the local spread of drugs which have been administered orally as pastilles for the treatment of tonsillitis and pharyngitis. A pastille of stiff gelatin and containing 1 percent methylene blue in place of penicillin was tested in 50 subjects all of whom were sitting upright; mouths were examined after 5 and 15 minutes. The pastille was held in the buccal fold between cheek and teeth and allowed to dissolve without agitation. Results indicated that the uvula and tonsillar areas were reached by the dye to a sufficient extent while the pharyngeal area remained almost completely unstained. It is suggested that the flow of saliva at the back of the mouth and the swallowing mechanism function in such a way that the saliva does not bathe the pharyngeal region as it does the oral cavity and hence does not carry sufficient dye or drug with it to this region.

Macht, David I., 1948. INFLUENCE OF HUMAN SALIVA AND BLOOD SERUM ON GERMINATION AND ROOT GROWTH. Science, 108 (2812): 565

The germination-inhibiting property of saliva (Yardeni, D.) is considered to be more appropriately attributed to some unknown toxin or toxic substance in saliva and other body fluids rather than to growth hormone (Kramer et al.). A previous investigation (Macht et al.) showed a 1% solution of women's saliva to be toxic to plant germination and root growth with menstrual saliva showing the greatest inhibiting effect.

MacKay, Margaret E., 1927. HISTAMINE AND SALIVARY SECRETION. Amer. Jour. Physiol., 82 (3): 546-556.

Cats and dogs were anesthetized in most cases with a chloroform-ether mixture followed by an intravenous injection of chloralose (0.1 g./kg. of body weight). Chorda and sympathetic nerves were severed; a cannula was inserted in the duct of the submaxillary gland. Doses of histamine

phosphate, 0.25-0.5 mg. for cats, and 1-2 mg. for dogs, were injected into the femoral vein.

In a large number of experiments on both cats and dogs anesthetized with chloralose, ether, or chloroform, histamine caused a slight spontaneous secretion in 50% of the cases.

In the experiments on the action of histamine upon the response of the gland to stimulation of the secretory nerve, chorda secretion was not increased after histamine; similar negative results were also observed with sympathetic stimulation.

Another experiment showed that there was a marked inhibition in the secretion when histamine was administered after pilocarpine in cats. Different results were obtained in the dog, histamine usually giving an acceleration of secretion and an inhibition only after large doses of pilocarpine.

Increased secretion from histamine was obtained after chorda stimulation, although histamine alone had no effect.

It was concluded that from the results reported, histamine has a two-fold action on the submaxillary gland: (1) it stimulates the contractile elements, and (2) activates the nervoglandular apparatus of the organ. (cf. MacKay, 1929m.)

MacKay, Margaret E., 1929. FURTHER DATA CONCERNING THE HISTAMINE SALIVARY SECRETION. Amer. Jour. Physiol., 91 (1): 123-131.

The influence of certain drugs on histamine-induced salivary secretion was studied in dogs and cats anesthetized with chloralose (0.1 g./kg. body weight). A cannula was inserted in the duct of the submaxillary gland and connected to a Gibbs drop recorder. The chorda lingual and cervical sympathetic nerves were cut and the blood pressure was recorded in the carotid artery. Histamine acid phosphate (1/4-1/2 mg.) was used. Representative examples of each experiment are given in tables 1 to 5.

Ergotamine methasulphonate, (4-5 mg./kg.) produced paralysis of the sympathetic nervous system, but did not abolish the histamine-augmented secretion obtained after chorda stimulation. Although in most cases ergotamine had no effect on the quantity of saliva secreted after histamine had been administered, diminution in secretion was observed in a few instances. A dose of atropine, sufficient to paralyze the secretory activity of the chorda tympani of an ergotamized cat, lessened but did not abolish the effect of the histamine.

In a comparison between the action of pituitrin and histamine, it was observed that neither by itself nor after stimulation of the chorda tympani did pituitrin give more than one drop of saliva. The inhibitory effect of pituitrin on the salivary flow, which was induced by a rhythmic stimulation of the chorda tympani, was explained on the basis of the drug's constricting action on the glandular vessels. In special experiments on dogs, the blood flow was recorded in addition to the usual preparation. Stimulation of the chorda for 15 sec. gave a profuse flow of saliva and an increased blood flow. Injection of 1/2 cc. pituitrin produced only one drop of saliva and stopped the circulation through the gland for 9-1/2 min.

Small doses of adrenalin gave an augmented secretion after stimulation of the chorda, although adrenalin alone did not produce a secretion. (cf. MacKay, 1927m.)

Maevsky, W. E., 1922. THE SYMPATHETIC INNERVATION AND THE PROCESS OF NORMAL SALIVARY SECRETION. Jour. Physiol., 57 (5): 307-312.

A study was made of the relation of the sympathetic nerve fibers to the reflex secretion of saliva. The investigation was performed on 1 dog with permanent fistulas of the submaxillary and sublingual glands and the parotid gland on the left side. The sympathetic nerve is considered to have an important significance in the process of normal saliva secretion.

Maevskii, V. E., 1928. K VOPROSU O KACHESTVENNYKH IZMENENIIĖKH SLIŪNY PRI POVTORNYKH RAZDRAZHENIIĖKH V OSTRYKH I KHRONICHESKIKH OPYTAKH [On the qualitative changes in saliva during repeated stimulation in severe and chronic experimentation]. Odesskii med. Zhur. (Odessa), 3 (2): 63-68.

The qualitative changes in salivary secretion were studied in dogs under short-termed and prolonged experimentation. In 13 prolonged experiments the submaxillary glands were fistulated; in 7 short-termed experiments Wharton's ducts were cannulated bilaterally while the animals were under morphine-chloroform anesthesia. In the latter experiments the resected and ligated chordo-lingual nerve was stimulated by faradic current, or the nerve was left intact and electrodes placed under the chorda tympani. Other experimentation included the decerebration of the animal, accompanied by faradic stimulation of the intact chorda tympani; the injection of pilocarpine before nerve resection or chordal stimulation; the injection of pilocarpine and concomitant feeding of rusk-powder; the subcutaneous injection of apomorphine (an alkaloid relaxant and expectorant) to permit stimulation of the salivary center without participation of the afferent reflex arc and the higher departments of the central nervous system; and the oral administration of dilute HCl. Viscosimetric measurements of the saliva were made in each experiment, and the rate of salivary secretion was determined in each minute-sample. The following conclusions were drawn: (1) Each stimulation which reaches the submaxillary gland of the dog contributes to the increase of organic matter in the saliva. This increase depends in a large measure upon changes in the glandular cells under the influence of the preceding stimulation. (2) Stimulation of the chorda tympani in various short-termed experiments induces a change in the salivary gland which is manifested by a great increase in salivary viscosity and a stable secretory rate. (3) Stimulation of the salivary center by apomorphine elicits a salivary secretion of increasing viscosity. (4) A saliva rich in mucin was secreted in response to repeated acid stimulation.

Magee, Catherine, C. L. Drain, and J. D. Boyd, 1929. DENTAL CARIES: INFLUENCE OF POTENTIAL MOUTH ACIDITY. Proc. Soc. exper. Biol. Med., 26 (8): 718-719.

Three children with active caries were placed on a supervised diet and their caries activity became arrested in less than 3 months. That mouth acidity was not a prime factor in caries development was obvious from the fact that the potential mouth pH did not differ significantly before and after the dietary period.

Magitot, E., 1866. ÉTUDES ET EXPÉRIENCES SUR LA SALIVE CONSIDÉRÉE COMME AGENT DE LA CARIE

DENTAIR. [Studies and experiments on saliva considered an agent of dental caries]. Compt. rend. de la Soc. de Biol. (Paris), 18, Mém., p. 3-67.

A review of the composition of saliva and its role in the development of dental caries is followed by a series of experiments to test the effects of fermenting sugars, various organic acids, sodium chloride, and tannin. The author concludes that decay is purely a chemical change of the dentin and enamel of the teeth. Saliva serves as the medium for acid fermentation and the vehicle for foreign substances such as citric acid which can directly attack the enamel or dentin.

The mechanism of dental decay is a simple dissolving of the mineral-salts of enamel and dentin.

Magoun, H. W., and Lindsay E. Beaton, 1942. THE SALIVARY MOTOR NUCLEI IN THE MONKEY. Amer. Jour. Physiol., 136 (5): 720-725.

Experiments on the medulla oblongata of 8 monkeys revealed a region where electrical stimulation resulted in ipsilateral submaxillary and parotid gland salivation. This region lies in the dorsal midline area between the genu of the facial nerve and the hypoglossal nucleus, extending laterally and ventrally through the reticular formation to the exits of the seventh and ninth nerves. While some overlap existed, submaxillary responses were elicited mainly from the rostral part, parotid responses mainly from the caudal part of this region.

Mahler, Inga R., and Vincent F. Lisanti, 1952. HYALURONIDASE-PRODUCING MICROORGANISMS FROM HUMAN SALIVA. Oral Surg., 5 (11): 1235-1240.

A technique for the determination of hyaluronidase activity in saliva, a modification of that by Lisanti [cf. Lisanti, 1950m], is discussed in detail.

Bacteriological studies of sixty saliva samples indicated the presence of four hyaluronidase-producing organisms. The predominant of these, Streptococcus mitis, occurred in 55% of the samples, Micrococcus pyogenes var. aureus, in 18%; and streptococci of the Lancefield groups A and K, in 11%.

A marked increase in hyaluronidase titer occurred in patients having periodontal and upper respiratory disturbances.

Mahler, I. R., H. H. Chauncey, and V. F. Lisanti, 1955. LIPOLYTIC AND ESTEROLYTIC ACTIVITY OF SALIVARY ORGANISMS. Jour. Dental Res., 34 (5): 709.

Whole saliva was centrifuged and both the sediment, consisting chiefly of microorganisms, and the supernatant were tested for ability to hydrolyze 4 esters of beta-naphthol. In all cases both sediment and supernatant showed very strong activity against the acetate substrate; decreasing activity was noted in the following order: acetate, laurate, myristate, and stearate.

Microorganisms isolated from saliva and dental plaques showed marked variation in ability to attack these substrates. Sediments, from cultures of Streptococcus salivarius, and of a Lancefield Group L streptococcus, hydrolyzed acetate weakly to moderately. Lactobacillus casei hydrolyzed all esters but stearate. One strain of Streptococcus mitis attacked all 4 esters vigorously; Micrococcus pyogenes var. aureus, also showing marked activity against all esters, was the only organism tested which showed strong enzymatic activity in

its culture filtrate. This preliminary study indicates that many salivary organisms are only active against short-chain fatty acids; some are also active against long-chain fatty acid esters. Further differentiation is obtained in the comparison of exogenous and endogenous production of these enzymes. (From author's abstract)

Mahler, I. R., and H. H. Chauncey, 1957. LI-POLYTIC AND ESTEROLYTIC ACTIVITY OF SALIVA AND SALIVARY ORGANISMS. Jour. dent. Res., 36 (3): 388-342.

Saliva and 16 oral isolates were tested for lipolytic and esterolytic activity using β -naphthyl-acetate, β -naphthyl-laurate, β -naphthyl-myristate, and β -naphthyl-stearate. True lipase activity was shown only by isolates of Micrococcus pyogenes var. aureus. Saliva, 3 species of lactobacilli and certain of the gram-positive cocci exhibited an overlapping of enzymatic activity which manifested itself in a strong attack against β -naphthyl-acetate and a decreasing hydrolysis of β -naphthyl-laurate, β -naphthyl-myristate, and β -naphthyl-stearate. Micrococcus pyogenes var. albus and an isolate of Aerobacter aerogenes hydrolyzed only the acetate substrate. When tested against β -carbonaphthoxycholine iodide these organisms indicated the production of a pseudocholinesterase. (Author's summary)

Mahler, I. R., and R. S. Manly, 1958. BACTERICIDAL ACTION AND GLYCOLYTIC INHIBITION OF SELECTED CHEMICALS TESTED AGAINST ORAL MICROORGANISMS. Jour. Amer. dent. Assoc., 56 (6): 854-857.

The bactericidal action of 18 organic and inorganic compounds and their ability to inhibit glycolysis were tested against saliva sediment, samples of human dental plaque, and pure cultures of 4 oral organisms. Centrifuged cells, saliva sediment and plaque material in 0.02 ml. quantities were held in contact with a glass electrode by means of a fine-meshed nylon thimble. Determinations of pH were made after a 20-minute immersion in a buffered glucose solution, and again after 20-minute successive immersions in glucose buffer containing a test chemical and then in fresh glucose buffer. The pH differential indicated the residual inhibitory effect of the chemicals; their bactericidal activity was determined by standard culture methods.

No correlation was found between their bactericidal effects and glycolytic inhibition. Close resemblance was found between saliva sediment and other test materials in susceptibility to inhibitors.

Maierov, F. P., 1936. OB IZMENENIIĀKH TONUSA PICHCHEVOGO TSENTRA POD VLIĀNIEM USLOVNYKH REFLEKSOV [On the changes in the tonus of the food center under the influence of conditioned reflexes] Arkh. biol. Nauk, Leningrad, 42 (1-2): 99-101.

The effect on unconditioned salivary flow produced by conditioned salivary stimulation was studied in two dogs. A regular variation in the unconditioned salivary flow was noted in one dog dependent upon regularity of experimentation. A progressive decrease in unconditioned flow occurred with increase in number of non-test days interrupting the daily conditioned reflex experiments; unconditioned salivary flow increased when daily conditioned reflex tests were uninterrupted; the interruptions had no marked effect on conditioned salivation. The establishment of an increasing

number of conditioned salivary reflexes in the other dog was paralleled by an increase in its unconditioned salivary flow. Tonus of the cortical and subcortical food centers are chronically increased by positive conditioned salivary reflexes and are decreased by their absence.

Maj, Giorgio, and L. Bonora, 1943. VERÄNDERUNGEN DER AMYLOLYTISCHEN SPEICHELFUNKTION INFOLGE STOCKUNG DER PANKREATISCHEN AUSSENSEKRETION [Changes in the amylolytic function of the saliva following blocking of the external pancreatic secretion]. Pflüger's Arch. ges. Physiol., 246: (5): 749-756.

Experiments were carried out on three male dogs kept on a mixed diet for 13 to 29 days prior to the determination of the amylolytic function of the mixed saliva. During the waiting period, blood samples were taken from the vena saphena. Soon after, Santorini's canal and the duct of Wirsung were ligated. Following surgery the diet was gradually increased until on the 18th day it reached the amount consumed prior to the intervention. The amylolytic function tests were started as soon as carbohydrate was added to the diet of the dogs. Results indicated that the blocking of the pancreatic duct by ligature induced a marked increase in the amylolytic salivary function during the test period (about 78 days). There were no simultaneous changes noted in the diastase content of the blood. The density of the saliva did not change. The increased amylolytic activity of the saliva is considered as a simple compensation for the absent pancreatic fluid. Thus it became evident that the site of the enzyme (diastase) secretion is localized in the salivary glands.

Makhtinger, A. I., and A. I. A. Fedorov, 1933. KACHESTVENNYI SOSTAV SLIŬNY U DETEI IZ OTDEL'NYKH ZHELEZ [The qualitative composition of saliva from different glands in children]. Arkhiv. Biol. Nauk, Leningrad, 34 (5-6): 587-590.

The composition of saliva in response to various stimuli was studied in 3 children, 12 to 14 years of age. Stimuli used were 6 gm. of meat, cookies, or 30 gm. of a 0.5% citric acid solution, given on an empty stomach in 4 equal portions per minute during 3 min.; the stimulation was repeated four times in one day with 15 min. intervals. Each salivary sample was tested for the amount of enzymes (by Wohlgemuth's method), the dry residue, and the organic and inorganic content. The collection of saliva was done by Krasnogorskii's method.

A sharp difference was observed in the composition of parotid and submaxillary saliva in response to food and acids. Parotid saliva is much richer in enzymes as well as in dry residue, i.e. in organic substances, than submaxillary. Obviously, in children the parotid gland is the digestive organ, while the submaxillary gland is of minor importance. The opposite relationship is true in dogs, where the saliva of the "mixed" glands is much richer in organic matter and enzymes than the parotid saliva.

Results moreover show that it is not possible to draw a demarkation line between saliva elicited by food and by repellents, either in regard to enzymes or to dry residue (which confirms Biriukov's data).

Data for the viscosity of saliva generally correspond to those found in dogs, i.e. submaxillary saliva is of greater viscosity than parotid; only,

in dogs the viscosity is measured in minutes, in children in seconds. There is no essential difference in the salivary viscosity of either gland in response to food or to repellents.

To study the relation between the intensity of stimulation and the salivary secretion, special experiments were made in two children; 30 cc. of distilled water at 30°C. were given on an empty stomach, followed by different dilutions of hydrochloric acid (0.01 to 0.25%). Spontaneous parotid salivation was 0.1 cc./min., containing 1000 units of enzyme; spontaneous submaxillary salivation, 0.36 cc./min., containing 250 units of enzyme. In response to distilled water and to 0.01% HCl, the amount of saliva and its enzyme content remained the same. [Tabulated data with regard to the amount of submaxillary saliva appear to disagree with this conclusion]. The dry residue in the parotid saliva elicited by water was 0.62%, in the submaxillary 0.30%. In response to 0.05% muriatic acid, however, the amount of saliva, its enzyme content and dry residue were markedly increased. [Tabulated data appear to contradict this conclusion for dry residue in parotid saliva]. Saliva elicited in response to 0.25% muriatic acid was 1.3 cc. for the parotid, and 2.2 cc. for the submaxillary; the amount of enzyme and dry residue increased accordingly. Thus, an increased stimulation produces a corresponding increase in salivary secretion and an increase in enzyme and dry residue.

Malinovskii, O. V., 1953. BEZUSLOVNAIÂ SEKRETSIIÂ OKOLOUSHNOI ZHELEZY OBEZ'IIÂNY MAKAKA RESUS [Unconditioned secretion of the parotid gland of the macacus rhesus monkey]. Fiziol. Zhur. SSSR, 39 (1): 47-51.

Study was made of parotid saliva secreted in response to various foods in a 4-year old male macacus rhesus monkey whose salivary duct had been surgically exposed by the Pavlov-Glinskii method. The monkey was placed in a special stand, a metallic funnel was glued to its cheek and a glass balloon attached to it. The amount of secreted saliva was measured every 5 min. The animal was fed continuously with small portions and the saliva thus elicited was examined for its solid residue, minerals, general nitrogen, activity of the amylase, alkalinity and pH. Parotid secretion took place only in the presence of conditioned or unconditioned reflexes; there was no spontaneous salivation. The amount of saliva subsequent to natural conditioned stimulation did not exceed 0.1 - 0.2 ml. in 5 min. After unconditioned food stimulation, the amount of saliva in 5 min. changed from tenths of a milliliter to 3.5 ml. depending on the nature of the food. To determine the composition of the saliva 76 analyses were made of saliva obtained after 25 different food stimulants. The following figures were obtained: solid residue 1.7 - 8.0%, mineral residue 0.3 - 0.7%, general nitrogen 0.2 - 1.4%, non-albuminous nitrogen 0.03 - 0.06%, pH 8.2 - 8.5, amylase activity $38/30 = 4 \times 10^3$ to 1.28×10^5 in a 0.01% starch dilution.

The amount and quality of the saliva varied considerably depending on the type of food, remaining more or less stable for the same food. The difference in the quantity of the components of saliva to the same stimulant did not exceed 1 - 3%. As natural unconditioned stimulants the usual foods of the monkey were used, chalk and clay, used as mineral additions, a solution of sugar;

moreover, salivation in response to chewing of gum and lignine was observed. The results of giving the various foods, the resultant salivation and salivary analyses are tabulated. The findings indicate that the solid residue, the nitrogen content and the amylase activity vary proportionally. The fluctuations of the amount of saliva and its content are much larger and finer [?] than those of dogs, which indicates a higher capacity of adaptation to work in the monkey's gland. It is suggested that the vegetarian diet of the monkey and its variety are apparently the cause of this high adaptability of the salivary gland, of the high amylolytic properties of the saliva and its high alkaline reserve.

In a study of the influence of the mechanical and chemical components on the secretion of saliva, the feeding of very hard candy to the monkey produced a considerable secretion (1.4 ml. in 5 min.) with a low residue (2.1%). The same kind of candy softened in warm water produced a smaller amount of saliva (1.0 ml.) with a higher residue (4.8%). The content of nitrogen and the activity of amylase change correspondingly (to the residue). This shows the mechanic action on the stimulation of the oral tissue.

The saliva secreted after drinking of a sugar solution is characterized by its high nitrogen content. In this case the chemical stimulation of the oral tissue is the main factor. A raise in the concentration of the solution produces a sharp increase in the amount of saliva.

The chewing of gum and lignin (mechanical stimulation of the oral tissue) produces a secretion with a very low residue. When the lignin is dipped in a sugar solution, the amount of saliva increases slightly, and the residue content increases more than 1.5 times.

Malkiman, I. V., 1933. K VOPROSU O VLIIANII DLITEL'NOGO UGLEVODISTOGO I ZHIROVOGO PITANIIÂ NA VYSSHUIÛ NERVNUIÛ DEIÂTEL'NOST' SOBAK [On the influence of the prolonged carbohydrate and fat diet on the higher nervous function in dogs]. Arkh. biol. Nauk, Leningrad, 33 (1-2): 97-105.

The influence of prolonged carbohydrate and fat diets on the conditioned reflex function was studied in two dogs. The usual method was applied in the working out of conditioned reflexes in response to the metronome (160 strokes/min.), bell, electric lamp of different intensity, and skin pricking in the side (30 or 24 pricks/30 sec.), and differentiations consisting in 60 metronome strokes/min., needle pricks on the shoulder, or of different frequency (15 pricks/30 sec.). Unconditioned stimulation was done by rusk powder. The carbohydrate diet consisted in soup of 600 gm. potatoes, 400 gm. black bread, and 200 gm. fresh cabbage; the fat diet, of 100 gm. butter or lard, and 200 to 300 gm. black bread. The dogs were fed at 4 p.m. daily.

The metronome and bell elicited a considerable salivation after a short period of latency; the light and the pricking produced less effect after a longer period of latency. Differentiations were very stable.

After passage from the mixed diet to the carbohydrate, first, a slight increase in the response to several conditioned stimuli is observed, together with an increase in the conditioned reflex; in the second phase, however, the salivary response to all conditioned stimuli diminishes, while the

conditioned reflex, after a very slight decrease, begins to improve progressively.

After passage from the carbohydrate to the fat diet, the secretory response to all conditioned stimuli increases, then stabilizes at the level of the mixed food diet. The unconditioned reflex, after a very slight increase, diminishes progressively. In prolonged diets, the difference in the response to strong and weak conditioned stimuli decreases.

Malkina, D. T., 1951. VLIÏÂNIE UDALENIIÂ NAD-POCHECHNIKOV NA SLIUNOOTDELENIE, VYZVANNOE RAZ-LICHNYMI PISHCHEVYMI RAZDRAZHITELIAMI [The influence of the extirpation of the suprarenal glands on the salivary secretion elicited by various food stimuli]. Fiziol. Zhur. SSSR, 1951 (3): 349-353. Abst.: Sovet. med. refer. Obozrenie, Fiziol., 1952 (12): 69.

The effect of suprarenal gland extirpation on salivary secretion was studied in dogs having parotid fistulas. Salivary secretion was elicited by feedings with rusk powder, meat, or milk at 15-minute intervals. The salivary samples were weighed, dried and calcined to determine the dry residue and organic content. After establishment of the normal secretion standards, one suprarenal gland was extirpated and the other decorticated. Observations of salivary secretion were continued from the second to third post-operative day until the thirtieth.

Results showed that the exclusion of the chromaffin tissue of the suprarenal glands decreases the rate of flow while prolonging salivary secretion elicited in response to various food stimuli. In response to bread, the organic content of saliva was greatly decreased; in response to meat this decrease was less pronounced. Salivary secretion approaches normal, after extirpation of the suprarenal chromaffin tissue, when systematic injections of adrenalin are given.

Malloizel, Lucien, 1902. ÉTUDE DES CONDITIONS DE LA SÉCRÉTION SALIVAIRE DE LA GLANDE SOUS-MAXILLAIRE [Study of the conditions of salivary secretion from the submaxillary gland]. Compt. rend. de la Soc. de Biol. (Paris), 54 (10): 329-331.

A study was made of submaxillary salivation in 2 dogs using raw meat, sugar, common salt, quinine sulfate, magnesium sulfate, 1% acetic acid, and sand, as well as fragrant substances (essence of lavender, cloves, etc.) in wads of cotton. Psychic saliva response was induced equally by raw meat and sugar.

The saliva produced always showed an alkaline reaction to litmus and never contained thiocyanates.

The interval between stimulation and flow of saliva varied with the substance used, being most rapid for the raw meat and slowest for sugar and sand.

The quantity of saliva also varied being greatest for acetic acid, salt, and quinine sulfate and least with sand. Olfactory stimulation was transitory, ceasing after producing 0.5 to 2 cc. of saliva.

The viscosity and mucin content were greatest after stimulation by raw meat and least when stimulated by salt, quinine sulfate, sand, and fragrant substances. Reflex saliva induced by raw meat was more viscous than that produced by sugar.

Malloizel, Lucien, 1902a. SUR LA SÉCRÉTION DE LA GLANDE SOUS-MAXILLAIRE, APRÈS INJECTIONS SOUS-

CUTANÉES DE PILOCARPINE [On the secretion of the submaxillary gland after subcutaneous injection of pilocarpine]. Compt. rend. de la Soc. de Biol. (Paris), 54 (15): 477-479.

Pilocarpine hydrochloride was injected subcutaneously into dogs to study rate of submaxillary secretion, mucin content of the saliva during secretion, and diastasic activity of the saliva.

Secretion began 3 to 6 minutes after injection and continued at a high level for 12 minutes, then diminished to flow an hour at a constant rate about 1/2 of the first flow. At the end of the hour the flow dropped steadily.

The mucin content increased from a trace to a maximum in the first (5) minutes of flow to remain some time at a maximum before dropping. Viscosity paralleled the mucin content.

Diastasic activity, generally low in submaxillary saliva increased as the mucin content increased to a maximum, then dropped without returning to zero.

Injections of weaker solutions of pilocarpine caused later appearance of the first rapid flow of saliva as well as retardation in reaching a maximum in mucin content.

Malloizel, Lucien, 1902b. QUELQUES EXPÉRIENCES SUR LA SÉCRÉTION DE LA GLANDE SOUS-MAXILLAIRE PENDANT L'ACTION DE LA PILOCARPINE [Some experiments on the secretion of the submaxillary gland while activated by pilocarpine]. Compt. rend. de la Soc. de Biol. (Paris), 54 (15): 479-481.

A study was made of submaxillary salivation following subcutaneous injection of pilocarpine in a dog whose chorda tympani was cut on one side.

Salt placed on the tongue did not stimulate salivation in the denervated gland. Injection of pilocarpine established flow at the end of 6 minutes. This proceeded abundantly for 5 minutes before diminishing more rapidly than in the normal gland to maintain a constant flow for 3/4 hour, and then dropped steadily. The saliva, though less rich in mucin than at the end of the 15 minutes, was richer in mucin than that of the normal gland. Denervation resulted in saliva with lower than normal water content.

Stimulation by salt during the pilocarpine experiments caused an increase in flow of saliva which became transparent as the mucin content dropped.

Malloizel, Lucien, 1904. SÉCRÉTION SOUS-MAXILLAIRE CHEZ LE CHIEN A FISTULE PERMANENTE APRÈS LA SECTION DES NERFS GUSTATIFS [Submaxillary gland secretion in the dog with a permanent fistula after sectioning of the taste nerves]. Compt. rend. de la Soc. de Biol. (Paris), 56 (22): 1022-1024.

The response to taste and other stimuli was studied in two dogs. The lingual nerves of one, and the glosso-pharyngeal nerves of the other were cut. Various substances as salt, sugar, acetic acid, and raw meat were placed in the front and rear of the tongue. Raw meat always produced a viscid saliva, sugar, a somewhat more fluid saliva, and the remaining substances, fluid saliva. Substances placed on denervated areas produced little or no salivation.

Malloizel, Lucien, 1904a. SÉCRÉTION SOUS-MAXILLAIRE DU CHIEN APRÈS SECTION DES NERFS GUSTATIFS (SUITE) [Submaxillary gland secretion of the dog

after sectioning of the gustatory nerves (Continued)]. *Compt. rend. de la Soc. de Biol. (Paris)*, 56 (22): 1024-1026.

Experiments on submaxillary salivation showed that a dog with severed glosso-pharyngeal nerves produced reflex-stimulated saliva equal to a dog with severed lingual nerves in response to sugar but produced feeble response to taste stimulation and did not swallow.

If both lingual and glosso-pharyngeal nerves were cut, reflex salivation was abundant and viscous in response to meat and continued during chewing. Small amounts of substances as salt produced a feeble response while large amounts produced less than normal but abundant saliva especially during swallowing. This saliva was more viscid than normal.

Maltesos, C., and R. Weigmann, 1939. ÜBER DEN SEKRETIONSABLAUF DER UNTERKIEFERDRÜSE BEI CHORDAREIZUNG [The course of secretion of the submaxillary gland during stimulation of the chorda]. *Pflüger's Arch. ges. Physiol.*, 241 (5-6): 641-650.

The chorda tympani and the lingual nerve of anesthetized dogs were electrically stimulated. Salivary secretion was measured by means of a cannula inserted into the submaxillary gland. Stimulations were carried out with sinusoidal alternating current (frequency: 10-1500 Hz.), and condenser discharge (resistance capacitance: 10-20 milliseconds, with a stimulation interval of 1/2-1/4 second). Prolonged stimulation increased the speed of salivary secretion to the maximum, then it stayed constant for a while, only to decrease to zero at the end. Under the impact of high-frequency (50-150) Hz.) stimulation, the curve of salivation was broken (polyphasic); low frequency stimulation, on the other hand, resulted in a uniform salivary curve. It is assumed that this difference in response is due to failure of the glandular nerves when exposed to high frequencies. Stimulation with physostigmine influenced neither the position of the stimulation threshold, nor the shape of the secretion curve. When dogs treated with physostigmine were exposed to low frequency electric stimulation, the salivary flow increased considerably.

Manly, R. S., 1953. A METHOD FOR STUDY OF ACID PRODUCTION BY SALIVARY SEDIMENTS. *Jour. Dental Res.*, 32 (5): 666.

"A coherent mass of oral microorganisms and debris was obtained by centrifugation of whole, stimulated saliva at 3,000 r.p.m. for 20 minutes. One milliliter of the gelatinous precipitate was coated on a glass electrode and immersed in a solution at 37°C., containing 0.01 molar bicarbonate buffer and 0.2 molar glucose. The pH of the sediment usually dropped 2 units below that of the buffer solution within 20 minutes. A second glass electrode recorded the pH of the buffer solution. Both electrodes were connected to a Model R Beckman pH meter which operated through an automatic switch to give automatic recording of pH on a Brown six-place recorder. Under these conditions it was found that equilibrium is attained within a few minutes. The pH of the sediment reaches a constant value which changes only as the sediment loses activity. Apparently the equilibrium represents a balance between rate of acid formation and rates of diffusion of acid outward and buffer inward.

Equilibrium can be disturbed or changed by agitation of the external solution, change of temperature, pH or buffer capacity of the solution in contact with the sediment, or introduction of a substance capable of inhibiting acid formation." (Author's abstract)

Manly, R. S., 1954. A METHOD FOR STUDY OF ACID PRODUCTION BY SALIVARY SEDIMENTS. *Jour. Dental Res.*, 33 (4): 561-570.

A description is given of an apparatus, designed to study the rate of acid production of salivary sediments, which uses a nylon mesh thimble holding the sediment in contact with a glass electrode to measure the pH of the precipitate, and a second uncovered glass electrode to measure the pH of the test solution. The pH differential between sediment and solution serves as an indicator of acid production or of the effectiveness of various acid inhibitors.

In a test of the apparatus, 0.1 ml. of a semi-solid precipitate from 15 ml. of paraffin-stimulated saliva, spun at 2400 rpm. for 20 minutes, was used in the thimble to cover the surface of the test electrode. The electrodes were immersed in a solution containing 0.2M glucose and 0.01 M CO₂-NaHCO₃ buffer; within 10 to 20 minutes the pH of the sediment dropped to an equilibrium value 1.5 to 2.5 pH units below that of the solution. The equilibrium was usually found to remain stable for several hours with a gradual loss in acid production rate. Addition of 0.1% NaF, changes in buffer concentration, and agitation of the solution have been found to affect the equilibrium pH.

Manly, R. S., and G. L. Hargreaves, 1954a. INHIBITION OF ACID PRODUCTION OF SALIVARY SEDIMENTS BY VARIOUS ETHERS, ESTERS, PHENOLS AND ALCOHOLS. *Jour. Dental Res.*, 33 (5): 672-673.

The ability of a large number of chemical substances to inhibit acid production in salivary sediments was studied either in water, or in 10% propylene glycol at concentrations ranging from 0.1 to 1.0%. One of 71 substances, having ether or ester linkage, depressed acid formation more than 60%; 42 of 229 alcohols, sometimes containing ether or ester, showed similar depressant ability. The presence of propylene glycol was needed in all cases to observe inhibiting action; this substance had a synergistic effect on 10 others. Phenol was found to be a more effective inhibitor than any of its derivatives tested at maximum concentration. Mono- or diethylene glycol ethers of alcohols possessed the same or less activity than the original alcohol. A few 1, 2 dihydroxy compounds including monopropanin and monobutylin, showed activity. Several of the effective compounds showed considerable resemblance to the pyranose structure for glucose. (From author's abstract)

Manly, R. S., and G. Hargreaves, 1957. INHIBITION OF ACID PRODUCTION OF SALIVARY SEDIMENT BY ETHERS, ESTERS, PHENOLS, AND ALCOHOLS. *Jour. dent. Res.*, 36 (1): 75-86.

A modification of the salivary sediment method (Manly, 1954) was used to test the capacity of 492 simple organic chemicals to reduce the acid formation rate of salivary sediment. Thirty ml. amounts of sediment, held against the active surface of a glass electrode by enclosure in a shaped nylon thimble, was immersed in a control solution (0.2 M

glucose, 0.01 M Na HCO₃-CO₂, 10% of pooled supernatant fluid from saliva) until a pH steady state was reached, then for 20 minutes in the control solution with a test solution added before reimmersion in fresh control solution. The inhibitory activity was calculated from the pH differential between control and test readings. Monosubstituted ethers and esters were found ineffective, while alcohols and phenols generally required the presence of 10% propylene glycol to show any inhibitory effects.

Manly, R. S., 1958. FILM THICKNESS AS A LIMITING FACTOR ON THE ABILITY OF VARIOUS CHEMICALS TO INHIBIT GLYCOLYSIS IN SALIVARY SEDIMENT. *Jour. dent. Res.*, 37 (5): 798-804.

Fifty-two chemicals, selected because of initial promise as glycolysis inhibitors, were tested for their inhibitory action on 3 different thicknesses of thin films of salivary sediment. Film thicknesses of 0.2, 0.5, and 0.9 mm. were prepared in contact with a glass electrode and supported by stiffened nylon mesh. After the pH drop had been measured in a control solution, the sediment was treated with a solution of the test chemical containing 20 per cent or less of propylene glycol as an accessory solvent. Next, the electrodes were transferred to the control solution for 1 hour to allow attainment of a new steady state. The percentage recovery was calculated from the ratio of the second to the first control pH differentials. The results were grouped according to the recoveries at 0.2 mm. thicknesses and averaged in 5 groups. Recovery was generally proportional to thickness. The most inhibitory group of chemicals were affected to the greatest extent by change in thickness. The groups of chemicals showing more than 40 per cent recovery on 0.2 mm. films possessed little or no inhibitory action when tested on 0.9 mm. films. (Author's summary)

Manners, D. J., 1953. THE ENZYMATIC DEGRADATION OF STARCH AND GLYCOGEN. *Ann. Rep. Prog. Chem. (Chem. Soc., London)*, 50: 288-301.

Studies are reviewed concerning the action of various amylases (including salivary amylase) on starches and glycogen.

Manouélian, Yervante, 1935. NEURONES VIRULENTS ET INFECTION DE LA SALIVA AU COURS DE LA RAGE. [Virulent neurons and infection of saliva during rabies]. *Compt. rend. Soc. Biol. (Paris)*, 119: 256-257.

The virulent saliva of rabies is considered to result from parasitized nerve cells found to occur near the acini and excretory canals of the salivary glands in the dog and rabbit.

Manouélian, Y., 1939. STRUCTURE DE LA LANGUE CHEZ LES MAMMIFERES, TROPISME DE CERTAINS VIRUS ET MÉCANISME DE L'INFECTION DE LA SALIVE [Structure of the tongue in mammals, tropism of certain viruses and the mechanism of infection of saliva]. *Compt. rend. Soc. Biol. (Paris)*, 131: 1012-1015.

In a discussion of various rat tissues invaded by *S. morsus muris* [*Spirillum minus*] it is suggested that the organism, rarely seen in the salivary glands and absent in the saliva, may periodically enter the saliva by way of minute lacerations of the tongue tissue.

Marenzi, A. D., and J. J. Rossignoli, 1928. POUVOIR TAMPON DE LA SALIVE [The buffer power of

saliva]. *Compt. rend. de la Soc. de Biol. (Paris)*, 99 (20): 176-178.

In saliva collected under liquid paraffin the determinations of pH (colometrically and electrometrically) and CO₂, made 15 minutes apart, show no clear variations in an hour. The dissociation curve of CO₂ in saliva compared to that in the blood shows that CO₂ provides the buffer power to saliva. At a CO₂ tension of 10-25 mm. Hg, which is the average in the mouth, saliva contains 12-18 cc. of CO₂ per 100 cc. of which 11-18 are in the form of bicarbonate. Analysis showed the buffering power of saliva to be very feeble and the pH variations to be much greater than those observed for the blood.

Markoff, J., 1913. FORTGESETZTE UNTERSUCHUNGEN ÜBER DIE GÄRUNGSPROZESSE BEI DER VERDAUUNG DER WIEDERKÄUER UND DES SCHWEINES [Subsequent examination of the fermentation processes in the digestion of ruminants and in swine]. *Biochem Zeitschr.*, 57 (1-2): 1-69.

An analysis of the saliva of ruminants and the relationship of the saliva to fermentation in the paunch is included in the extensive study.

Markova, A. A., A. T. Gubar', T. A. Mal'tseva, F. A. Oreshuk, 1955. SEKRETORNAIA DEIATEL'NOST' GLAVNYKH PISHCHEVARITEL'NYKH ZHELEZ POSLE UDALENIIA KORY BOL'SHIKH POLUSHARII GOLOVNOGO MOZGA [Secretory activity of the main digestive glands after removal of the cerebral cortex]. In: VIII Vsesoiuz. S'ezd Fiziol., Biokhim. i Framakol., Moscow, 1955, p. 397-398. *Abstr.: Sovet. med. refer. Obozrenie, Fiziol.*, 1956 (27): 81

The effect of cerebral decortication on secretion of parotid saliva was studied in the dog. Bilateral parotid secretion was unequal in the normal animal in response to dry food, the difference in rate not usually exceeding 10%; salivation was always greater on the stimulated side in response to hydrochloric acid. Decortication of one cerebral hemisphere produced marked change in the rate of flow of parotid saliva. Flow rate decreased 2.5 to 3 times from the gland on the decorticated side and increased slightly above normal on the intact side in response to all stimulants used. The total secretion of parotid saliva decreased immediately after the operation and remained constant at the depressed level over one year on the operated side. The effects of cerebral decortication on gastric and bile secretions are described.

Marshall, E. D., Jr., K. Emerson, Jr., and W. C. Cutting, 1937. THE DISTRIBUTION OF SULFANILAMIDE IN THE ORGANISM. *Jour. Pharmacol. exper. Therap.*, 61 (2): 196-204.

A study is presented of the sulfanilamide concentration of various tissues and fluids of the body. After intravenous injection, sulfanilamide was recovered from salivary samples of dogs in lower concentrations than that recovered from the blood.

Marshall, John Albert, 1915. THE NEUTRALIZING POWER OF SALIVA IN ITS RELATION TO DENTAL CARIES. *Amer. Jour. Physiol.*, 36 (3): 260-279.

The author reviews the literature on the neutralizing power of saliva.

In one set of experiments, saliva samples were obtained from three groups: (1) convalescent hospital patients (not taking medication), (2) prison inmates in good health, and (3) asylum inmates

"who were not entirely mentally deficient." Resting saliva samples were collected by spitting without effort.

For the determinations of alkalinity, 10 cc. of saliva are diluted with 20 cc. of distilled water; to this is added about 8 drops of an aqueous solution of para-nitro-phenol and a measured quantity of N/200 HCl run in. Mucin is thereby precipitated and the determination of the end point made in the clarified solution. N/200 NH_4OH is added until the first faint trace of yellow is discernible. Difference between the amount of acid added in the first instance and the amount of alkali added in the second, equals the alkalinity of the saliva in terms of cubic centimeters of N/200 HCl.

For acidity determinations, a second 10 cc. sample of saliva is diluted as before and about 4 drops of phenolphthalein are added. N/200 NaOH is run in until the first permanent pink color appears. The amount of alkali which has been added equals the acidity of the sample in terms of cubic centimeters of N/200 NaOH.

Table 1 and 2, 7 and 8 show the results of titration of resting saliva in the caries-free subjects.

In another set of experiments in comparing the neutralizing power of normal resting saliva and paraffin-activated saliva (Tables 9 and 10), two classes of subjects were used: (1) persons regularly engaged in daily routine--students, office force, etc.; (2) convalescent patients in surgical wards (taking no medication). The neutralizing power was found by adding together the results of titration with acids and alkali. From this comparison, a ratio, expressed in per cent, between the neutralizing power of normal resting saliva and that of the activated saliva was made and called the "salivary factor." The magnitude of this factor in caries-free persons varied between 43 and 80%. In other words, the neutralizing power of the normal resting saliva is 43 to 80% of the neutralizing power of the activated saliva and a reserve neutralizing power may be secreted under the necessary stimulus.

Data regarding carious mouths are given.

Marshall, John Albert, 1916. REPLY TO CRITICISM OF THE VALUE OF THE SALIVARY FACTOR AS AN AID IN THE DIAGNOSIS OF DENTAL CARIES. *Dental Cosmos*, 58 (11): 1225-1228.

A discussion is given of pH indicators used in titration of saliva samples. The author considers that while the pH of saliva may vary within relatively wide limits, the total neutralizing power remains relatively constant. Variation in pH occurs from day to day and with different salivation stimuli. Comparison of samples should be made only among those produced under similar conditions, with saliva produced under the mechanical stimulus of paraffin used as a control. A correlation is made between the neutralizing power of saliva and incidence of caries.

Marshall, John Albert, 1916a. THE SALIVARY FACTOR AND ITS RELATION TO DENTAL CARIES AND IMMUNITY IN DEMENTIA PRAECOX AND EPILEPSY. *Amer. Jour. Physiol.*, 40 (1): 1-11.

In continuation of a study (cf. Marshall, 1915m) on the neutralizing power of saliva, a series of analyses were made on dementia praecox and epileptic patients with and without caries. No data on normal individuals are given.

The ratio of the neutralizing powers (power to maintain neutrality) of the resting saliva and of the paraffin-activated saliva (called the salivary factor) fell below 80% in the caries-free subjects and exceeded this figure in persons with carious teeth.

The authors concluded:

"1. That the neutralizing power of the saliva secreted by individuals suffering from dementia praecox bears a definite relationship to oral conditions.

"2. That this relationship is the same as that observed in the normal individuals.

"3. That the neutralizing power of the saliva secreted by individuals suffering from epilepsy shows the same relationship to all conditions.

"4. That during the time of muscular activity incident to an epileptic seizure the acidity of the saliva is markedly increased.

"5. That the alkalinity of saliva produced during this period of stress is correspondingly lowered thus holding constant its total neutralizing power.

"6. That the normality of the saliva is regained within thirty minutes after symptoms of the seizure have subsided." (Author's summary.)

Marshall, John Albert, 1917. THE COMPOSITION OF SALIVA IN RELATION TO THE INCIDENCE OF DENTAL CARIES. *Jour. nation. [Amer.] dental Assoc.*, 4 (8): 881-888.

The total neutralizing power of saliva is chiefly attributable to inorganic constituents, as shown by dialysis.

A correlation was observed between the concentration of inorganic constituents, the amino-nitrogen content and the neutralizing power of saliva: a high neutralizing power occurred in conjunction with a high percentage of inorganic constituents and a low percentage of protein.

A tabulated survey of literature data supports the views of Pickerill (The prevention of dental caries and oral sepsis. 2nd. ed., Philadelphia, 1914.) that protein-eating races as well as those whose diet is primarily carbohydrate in nature are equally susceptible to dental caries and that the primitive races do not seem to be more immune to caries than the so-called civilized ones.

When the effects of various stimuli on the neutralizing power of saliva were observed, it was seen that a sweet stimulus (sucrose) produced saliva low in neutralizing power, while that stimulated by quinine was high in neutralizing power.

Marshall, John Albert, 1917a. THE COMPOSITION OF SALIVA IN RELATION TO THE INCIDENT OF DENTAL CARIES. *Jour. nation. [Amer.] dental Assoc.*, 4 (7): 775-782.

The values obtained in the chemical analyses of salivas obtained from caries-free and from carious individuals were compared in an effort to establish a relationship between the chemical constituents of saliva and the caries incidence. It was seen that the composition and the neutralizing action of resting saliva of carious persons approximates the values of the stimulated salivas of caries-free persons, suggestive of a condition resembling constant stimulation in the carious persons--which may be provided by the carious teeth themselves.

Five tables of data.

Marshall, John Albert, 1917b. A FURTHER DISCUSSION OF THE SALIVARY FACTOR AS AN AID IN THE DIAGNOSIS OF DENTAL CARIES OR IMMUNITY THEREFROM. *Dental Cosmos*, 59 (1): 33-36.

The observed power of saliva to maintain its pH, as shown by the indicator ranges of phenolphthalein and p-nitrophenol, is considered relatively constant and of diagnostic use. Activated saliva has been found to possess greater buffering power, between the observed limits, than normal resting saliva.

Marshall, John Albert, 1917c. THE COMPOSITION OF SALIVA IN RELATION TO THE INCIDENCE OF DENTAL CARIES. *Amer. Jour. Physiol.*, 43 (2): 212-234.

The data presented in this paper are based on the author's previous investigations on human saliva (cf. Marshall, 1915m, 1916m).

In one series, the effect of diffusible and non-diffusible substances in determining the neutralizing power of saliva was studied as follows: Collodion thimbles were fabricated from a solution of gun cotton in ether-alcohol, and then placed in recently boiled distilled water. 2-5 cc. of saliva were measured into the thimble, which was then placed in a small bottle containing boiled distilled water. The bottle was corked and placed in an air-tight cabinet for 24 hrs. at a temperature of 20-24°C, then the liquid outside the membrane was titrated separately from that of the inside membrane. Data based on 12-, 36-, and 48-hr. dialyses showed a wider variation than that based on the 24-hr. tests.

The author states that the analyses, although of questionable quantitative value, demonstrate, qualitatively, that the greater percentage of alkalinity, which is due to inorganic constituents, is found in that portion of the sample which has dialyzed through the membrane.

In another series, the amount of amino-nitrogen yielded by hydrolysis of normal resting and activated salivas was studied, utilizing the Van Slyke apparatus. 10 cc. of well mixed saliva were measured into a special digestive tube and 4 cc. of concentrated HCl were added. The open end of the tube was drawn out and sealed. The closed tube was placed in a water bath and digested at 100°C for 4 hr. 2 cc. of the hydrolyzed sample were run into the decomposing bulb of the Van Slyke apparatus. The bulb was shaken for 10 min.; the NO was absorbed by the permanganate solution. The volume of the nitrogen was read and the temperature and pressure noted.

In the greater number of the caries-free persons the nitrogen content of the resting saliva is appreciably higher than that of the paraffin-activated saliva. These facts substantiate the work done in the previous dialysis series, for it was shown that the increase of total neutralizing power of paraffin saliva from caries-free cases was due to a large amount of inorganic constituents. The nitrogen tests demonstrate that a smaller percentage of organic bodies, represented by the amino-nitrogen values, is contained in the paraffin-stimulated saliva and that therefore the difference in titration equivalents must be due to inorganic material.

The average values for the caries-free salivas was 4.47 cc. amino-nitrogen per 10 cc. resting saliva and 3.63 cc. for paraffin-activated saliva.

In another series, the difference in titratable acidity and alkalinity was determined by

simulating different parts of the oral mucosa with electric current from an inductorium. The amount of current used and the locality at which it was applied did not appear to produce any marked deviation from the general result. Electrodes were placed in the opening of Stenson's duct, Wharton's duct, the ducts of Bartholin, the tongue, and gingivae. The alkalinity of the electrically excited saliva was lower than that of the paraffin sample; the acidity of the electrically stimulated saliva was relatively higher than that of the paraffin-activated; and the neutralizing power of the saliva in electrical stimulation was lower in every instance than that of paraffin-stimulated saliva.

The action of a sweet stimulant, sucrose, tended to lower the total neutralizing power of the saliva; the bitter stimulant, quinine, produced the opposite condition yielding saliva resembling that secreted by paraffin stimulation.

Data are also given on the relation of the composition of saliva to the incidence of dental caries.

Marshall-Day, C. D., K. L. Shourie, J. W. Hein, S. W. Leung, and N. S. Simmons, 1949. ORAL BACTERIOLOGICAL STUDIES IN PUERTO RICAN CHILDREN. *Jour. dental Res.*, 28 (6): 648-649.

"Samples of saliva collected from 564 14-year-old boys from six Puerto Rican localities were air mailed to the bacteriological laboratory of the New York State Department of Health for *Lactobacillus acidophilus*, cocci, and yeast counts. In 312 of these cases duplicate samples were sent to the Michigan Caries Control Laboratory for lactobacillus counts only. The average period between collection and analyses was 3 days, the maximum being 4 days. *L. acidophilus* counts of the duplicate samples showed a high coefficient of correlation between the two laboratories (0.74). The standard product moment correlation between the lactobacillus counts and the D.M.F. teeth, number of open cavities (excluding roots), and D.M.F. areas were only 0.30, 0.33 and 0.33, respectively. Similar correlation between cocci and D.M.F. teeth gave a coefficient of 0.27. The correlation coefficients between lactobacillus counts and the amounts of gingival involvement and the amount of debris around the teeth were much lower. The data show no evidence that the l.a. count is closely correlated with either the cumulative caries experience or the gingival condition of the children." (Complete paper.)

Martin, D. J., and I. N. Hill, 1950. THE EVANSTON DENTAL CARIES STUDY. V. THE FLUORINE CONTENT OF SALIVA AND ITS RELATIONSHIP TO (A) ORAL LACTOBACILLUS COUNTS AND (B) THE PREVALENCE OF DENTAL CARIES. *Jour. dental Res.*, 29 (3): 291-297.

Stimulated-saliva samples of 2 groups of school children (6-8 year olds and 12-14 year olds) were examined for fluorine content and its relationship to lactobacillus counts was studied. Procedure is described in detail.

Saliva samples (5 to 8 cc. each) were pooled according to lactobacillus counts, separating negative specimens from positive ones.

In the 6 to 8 year group, 35 fluorine determinations representing 188 pooled saliva specimens (i. e. approximately 5 pooled specimens per analysis) showed that the fluorine content varied from 0.14 p.p.m. to 0.35 p.p.m., averaging 0.25 p.p.m., with a mean of 0.27 p.p.m. The lactobacillus

counts ranged from negative to 39,800 lactobacilli per cc. saliva. There was no apparent relationship between oral lactobacillus counts and salivary fluorine content.

In the 12-14-year age group, 28 fluorine determinations representing 124 pooled specimens (i.e. approximately 5 pooled specimens per analysis), the fluorine content varied from 0.11 p.p.m. to 0.29 p.p.m., averaging 0.20 p.p.m., with a mean of 0.20 p.p.m. The lactobacillus counts ranged from negative to 92,320 lactobacilli per cc. saliva. Again, there was no apparent relationship between oral lactobacillus count and salivary fluorine content.

Four tables of data are given.

Mathe, Charles P., 1948. WINE: ITS USE IN HEALTH AND DISEASE. *Med. Rec.*, 161 (1): 32-38.

Wine is discussed in this review as a hygienic beverage with emphasis on its food value, and its action on organs, systems, in pathologies, in old age, and as a medicative vehicle.

Wine increases salivation for a period of 10 minutes due to the reflex action of taste, and the action of the beverage on the glandular tissue and the nerve endings in the buccal mucosa. The presence of alcohol in wine does not affect salivary ptyalin, nor do light wines produce any irritative effects on the mucosa of the oral cavity.

Mathews, Albert, 1898. THE PHYSIOLOGY OF SECRETION. *Ann. New York Acad. Sci.*, 11 (14): 293-368.

An extensive discussion is presented concerning previous literature and original experimental findings concerning the following subjects: criticism of the secretory nerve theory, sympathetic salivary secretion, secretions due to muscle actions, salivary secretion following stimulation of the vasodilator nerves, and the secretions of the pancreas and sweat glands.

Mathews, Albert P., 1901. THE SPONTANEOUS SECRETION OF SALIVA AND THE ACTION OF ATROPINE. *Amer. Jour. Physiol.*, 4 (9): 482-499.

Nine experiments were made on the rate of secretion of the submaxillary gland of dogs under various conditions and on the effect of atropine on that rate.

Results showed: "1. If the blood supply is cut off from the submaxillary gland of the dog for 12-25 minutes, on readmission of the blood the gland secretes rapidly and continuously for several minutes. This secretion is accompanied by a marked vasodilation and is probably due to the increased osmotic pressure of the cells of the gland following the deprivation of oxygen and its readmission.

2. This secretion is closely dependent on the blood flow. It generally ceases within a minute after clamping the artery.

3. The secretion is paralyzed by atropine. The drug atropine must hence act directly on the gland cells and its value as a witness for secretory nerves is seriously impaired." (Author's summary.)

The author attributes the spontaneous and long continued rapid secretion upon readmission of blood either to the action of nerve cells lying in the hilus of the gland or to the action of the gland cells themselves.

Mathis, Hermann, 1935. NORMAL CONSTITUENTS OF HUMAN SALIVA. *Jour. dental Res.*, 15 (3-4): 195.

Chemical analyses of the salivas of six healthy individuals revealed that the mean values for K (averages of several determinations for each subject) varied from 60.3 to 82.4 mg./100 cc. saliva; for Ca, from 4.5 to 6.0 mg./100 cc.; for P from 13.3 to 17.2 mg./100 cc.; for Na, from 29.6 to 115.0 mg./100 cc.; and for Cl, from 37.1 to 93.7 mg./100 cc. saliva.

Mathys, H., 1931. UNTERSUCHUNGEN ÜBER DIE PERMEABILITÄT DER ZELLE. XV. UNTERSUCHUNGEN ÜBER DIE PERMEABILITÄT DER FARBSTOFFE DURCH DIE SPEICHELDRÜSEN [Examination of the permeability of cells. XV. Examination of the permeability of dyes through the salivary glands]. *Biochem. Zeitschr.*, 234 (5-6): 419-440.

The passage of dyes (indigo carmin, sodium fluorescein, and erythrosyn) through the salivary glands of the rabbit was studied. The intraperitoneal or intramuscular injection of dye solutions was followed 10 to 40 minutes by the injection of pilocarpine. Saliva samples were collected through a glass tube inserted into the rabbit's mouth. Urine specimens of each animal were also collected regularly. Pilocarpine stimulation had no effect on the secretion of dyes into the saliva; however, dye was always found in the urine. The intramuscular injection of a specific diuretic did not enhance the passage of any of the dyes. Following injection of pure thyroxin, small amounts of fluorescein were found in the saliva. The increased permeability of cells of the salivary gland, manifested itself in the increase of salivary secretion and in the secretion of thyroxin. This in turn showed the strong permeability improving effect of the thyroid gland on inner secretion. The great discrepancy in the permeability of the cells of the salivary and renal glands became again evident.

Matt, Morris M., 1954. RELATIONSHIP OF GLUCOSAMINE LEVELS TO LACTOBACILLUS POPULATION IN HUMAN SALIVA. *Jour. Dental Res.*, 33 (5): 673-674.

The utilization of salivary glucosamine by the oral flora was confirmed in 7 different salivary samples. Addition of bactericides, phenol and fluorine, or heating to 100°C for 10 minutes completely inhibited utilization of the glucosamine. The glucosamine content and the salivary lactobacillus count were determined for 22 human salivas. The glucosamine content varied from 12 to 72 mg./100 ml. of saliva (mean value 34 mg./100), while lactobacillus counts ranged from 0 to 184,000 /ml. of saliva. A scatter diagram indicates a possible correlation between lactobacillus and glucosamine levels in human saliva. (From author's abstract)

Matt, M. M., and C. U. Grimes, 1958. CHEMICAL FRACTIONATION OF HUMAN SALIVA. *Jour. dent. Res.*, 37 (1): 27.

Techniques have been devised to extract salivary mucin, to split the salivary mucin into protein and carbohydrate fractions, and to study the acid mucopolysaccharide in saliva. Forty-five fasting samples of gauze-filtered saliva were acidified with acetic acid, the precipitate washed with water, redissolved in 0.5 N sodium hydroxide, and reprecipitated with acetic acid. The resulting precipitate was washed with water, alcohol, ether, dried and weighed. The salivary mucin precipitate

ranged from 51 mg. per cent to 2,068 mg. per cent. This precipitate was dissolved in 3-4 ml. of 0.5 N sodium hydroxide, at 37°C., and room temperature, each for 3 days. The solution was acidified with trichloroacetic acid and the precipitate (protein fraction) washed with water, alcohol, ether, dried and weighed. Protein fraction ranged from 2 to 83 mg. per cent of saliva. The product gives positive biuret and negative Molisch reaction. To supernatant, equal volume 95 per cent ethanol was added, the precipitate washed with ether, dried and weighed. The product gives negative biuret and positive Molisch reaction. The carbohydrate portion of the mucin, ranged from 2 to 65 mg. per cent. To precipitate out acid mucopolysaccharide, an aliquot of sample extracted with 0.5 N sodium hydroxide for 4 days in cold, neutralized extracts treated with 2 volumes 95 per cent ethanol. Yields of this fraction were 10 to 100 mg. per cent. Alcohol concentration of supernatant was increased to 84 per cent and a second precipitate (carbohydrate in nature) obtained. Yields of precipitate II ranged from 7 to 250 mg. per cent. (Author's abstract)

Maupetit, J., 1932. SUR LA TENUEUR DE LA SALIVE HUMAINE EN AMMONIAQUE ET EN URÉE [On the ammonia and urea content of human saliva]. *Compt. rend. Soc. Biol. (Paris)*, 109: 874-876.

Measurements were made of the amounts of ammonia N, of xanthidrol N, and of hypobromite N in filtrates of the salivas of 8 normal subjects and of 8 subjects having various pathological conditions. The salivary samples were collected in vessels containing trichloroacetic acid crystals to provide sterile samples.

Results show the combined amounts of ammonia N and xanthidrol N to approximately equal the amount of hypobromite N in the salivas of both healthy and pathologic subjects. The amount of hypobromite N varied from 150 to 200 mg./liter of saliva from normal subjects. No differences were noted in results obtained from test of the trichloroacetic acid filtrates made either immediately after or 3 weeks after collection of the salivary samples. Tests of normal saliva acidified immediately, and acidified 36 hours after collection, showed delayed sterilization to result in a marked drop in the xanthidrol N content and an increase in both hypobromite and ammonia N of the saliva.

Maupetit, J., 1933. L'ACIDE URIQUE DE LA SALIVE HUMAINE: SON RAPPORT AVEC L'ACIDE URIQUE DU SÉRUM SANGUIN. [Uric acid of human saliva: its relationship with the uric acid of blood serum]. *Compt. rend. Soc. Biol. (Paris)*, 114: 707-708.

A brief review is given of experimental measurement of the uric acid content of saliva. Accuracy can be obtained by collecting salivary samples over trichloroacetic acid. Blood serum contains roughly 1.5 times the amount of uric acid contained in the saliva which, in the normal state, varies between 15 and 45 mg. per liter of saliva.

Mayer, Walter Brem, 1929. A COMPARISON OF THE AMYLASE CONCENTRATION IN THE SALIVA OF INFANTS AND ADULTS. *Bull. Johns Hopkins Hosp.*, 44 (4): 246-247.

Determinations of the amylase concentration of the salivas of 6 infants (2 pre-mature and 4 full-term) indicated that infants, even if premature,

can digest starch from birth. The salivary amylase content of the two premature infants was 23 and 28 units [U = that amount of amylase required to reduce the initial viscosity 20 per cent in 60 minutes] of amylase per gram saliva; that of the full-term infants ranged from 37 to 444 U/g.

The amylase concentration in 3 adults ranged from 200 to 2850 U/g.

The amylase concentration of saliva increases with the individual's age.

Mayr, Julius K., 1931. UNTERSUCHUNGEN ZUR FUNKTION DES SPEICHEL [Examinations of the function of saliva]. *Klin. Wochenschr.*, 10 (27): 1257-1259.

Potential hydrogen values of saliva were determined under special conditions. Normal saliva had an acid reaction, and the output fluctuated daily. Results of pH determination depended greatly on time of the day. Following ingestion of a balanced meal, acid values were predominant in the saliva just as in the urine. In the experiment the alkalization or "SUAM" [Säureumschlag-Alkalimethode] method was used. The fasting patient drank first 1/2 L. water containing a few drops of hydrochloric acid, and two hours later 400 cc. water containing 15 g. sodium bicarbonate. Urine specimens were collected every half hour. While normal kidney function was characterized by a regular secretion curve in which increased pH values were noted, in case of renal condition delayed secretion was observed. The same results were observed when salivary pH values were tested. The urine and saliva pH values were not necessarily identical but usually in the same person either acid or base values were predominant in both secretions. When the base intake was raised to 30 g., a marked change in both urine and saliva secretion was noted. After ingestion of 15 gm. sodium carbonate, a certain increase of base values in the urine was simultaneous with a corresponding increase of acid values in the saliva.

In the next experiment renal function tests were carried out in renal patients and both urine and saliva secretion was measured at intervals. The disturbance of acid values of the urine, manifesting itself in a delayed increase, may be interpreted as a decrease of acid values; the increase of base values in the saliva was noted at the same time.

Mayr, J. K., 1934. UNTERSUCHUNGEN ÜBER EXCRETORISCHE FÄHIGKEITEN DES SPEICHEL [Examination of the excretory ability of the saliva]. *Klin. Wochenschr.*, 13 (36): 1270-1272.

The relationship of a renal condition and the secretory ability of the saliva are discussed. In case of a pathological condition of the kidney, certain substances are secreted which are also present in the saliva. When gold, salvarsan or bromine were injected intravenously, the discrepancy between the urinary and the salivary secretory curve was quite conspicuous; salivary secretion only began when urinary secretion had almost terminated. After injection of bismuth and calcium the metals were traced a few hours after their appearance in the urine. In one-third of the cases tested, no traces of the elements could be detected in the saliva. It is assumed that the salivary gland does not participate actively in the secretion of the mentioned substances; this process was merely due to the saturation of the surrounding salivary "environment."

McCance, R. A., 1938. THE EFFECT OF SALT DEFICIENCY IN MAN ON THE VOLUME OF THE EXTRACELLULAR FLUIDS, AND ON THE COMPOSITION OF SWEAT, SALIVA, GASTRIC JUICE AND CEREBROSPINAL FLUID. *Jour. Physiol.*, 92 (2): 208-218.

The effects of salt deficiency, in two humans, were noted on the compositions and other properties of extracellular fluid, saliva, gastric juice, sweat, and cerebrospinal fluid. The deficiency resulted in a decrease in volume and total body-weight percentage of extracellular fluid, and a sodium reduction in the four secretion-fluids; the sodium decrease in saliva and gastric juice is accompanied by a rise in potassium content. It was found that a decrease in chloride content occurred in gastric juice, sweat, and cerebrospinal fluid (c.s.f.), but that of the saliva remained rather constant. A reduced acidity of gastric juice, and a lowered c.s.f. osmotic pressure were also detected.

McClanahan, H. H., Jr., and William R. Amberston, 1935. BICARBONATE ELIMINATION THROUGH THE SALIVARY GLANDS UNDER NERVOUS AND CHEMICAL STIMULATION. *Jour. Pharmacol. and exper. Therap.*, 53 (2): 189-197.

Bicarbonate elimination, total O_2 and CO_2 , chloride content, and hydrogen ion concentration were quantitatively determined for the submaxillary glands of cats anesthetized with sodium barbitol. Pilocarpine, epinephrine, and chorda excitation were used as salivary stimulants.

Although the chloride content of saliva is ordinarily below that of the arterial blood, pilocarpine or nervous stimulation were found to more or less equalize the chloride content of these tissues. This fact, along with other evidence, confirmed the theory that salivary chloride varies with secretion rate.

Normally the bicarbonate content of chorda-submaxillary saliva is about the same as that of the arterial blood, but upon pilocarpine or epinephrine stimulation its amount is increased in saliva and is decreased in arterial blood (the increase in salivary bicarbonate is not of respiratory origin); thus, lowering the plasma bicarbonate and producing a temporary acidosis--a fact which might indicate the use of pilocarpine therapeutically.

Microquinhydrone pH-measurement techniques revealed that salivary hydrogen ion concentration varies inversely with that of the arterial blood supply.

McClelland, John R., 1922. THE INFLUENCE OF VARIOUS STIMULI UPON HUMAN SALIVA. *Amer. Jour. Physiol.*, 63 (1): 127-141.

The influence of various stimuli on the chemical properties of saliva was studied by comparison with unstimulated samples.

Experiments on four samples from as many individuals yielded the following results: Normal, unstimulated human saliva varies in hydrogen ion concentration, buffer index, amylolytic index, acid and alkaline reserves, and mucin content from individual to individual and in the same individual at various times. When stimulated by mastication, the pH is temporarily increased, regardless of the flavor of the stimulant (apple, orange, ice cream, bread, chocolate, various acids, clove, etc.). Generally, the more consistent the material chewed and the more rigorous the mechanical movements

involved in chewing, the more alkaline the pH. The amylolytic index (determined by the method of Wohlgemuth, 1908m) failed to be significantly affected by stimulation. The acid reserve usually decreased slightly with stimulation, while the alkaline reserve responded readily. The buffer index, the sum of the acid and alkaline reserves, responded irregularly. The content of mucin, only present in minute quantities (Usually less than 0.3% and occasionally less than 0.1%) was readily reduced by stimulation, and here also was dependent upon the degree of mechanical movement rather than flavor. No conclusions are formulated.

McClelland, John R., 1923. SOAP IN DENTIFRICES. *The Amer. Perfumer and Essential Oil Rev.*, 18 (3): 163.

A discursive-review is presented concerning the physiological criteria of dentifrice soaps, with special emphasis upon the salivary effects of soap, its alkalinity and its acidity.

McClelland, John R., 1924. DENTIFRICES AND THE SALIVA. EFFECT OF DENTIFRICES ON THE REACTION. *Dental Cosmos*, 66 (4): 425-429.

Mixed saliva collected daily from 4 subjects was found to vary in pH between individuals, and to vary in the same subject at different times. The saliva was collected without stimulation after preliminary experiments had shown that stimulation affected the pH; the variation was particularly noticeable when paraffin was chewed. Experiments testing the effects of 2 acid and 2 alkaline dentifrices on the pH of saliva showed the same individual variation in reaction. Changes in pH induced by the acid or alkaline dentifrices were slight, similar in degree, and in general were no greater than that induced under the stimulus of brushing the teeth with a dry brush. Changes that did occur remained only as long as some of the dentifrice remained in the saliva and disappeared in all cases within 30 minutes.

McClelland, John R., 1924a. DENTIFRICES AND THE SALIVA. EFFECT OF DENTIFRICES ON THE SALIVARY ENZYME. *Dental Cosmos*, 66 (7): 751-753.

A determination was made of the amylolytic indexes of the salivas of 4 subjects. The saliva was collected without stimulation, and collected after brushing either with an acid or an alkaline dentifrice. No change from the normal ptyalin content of the saliva was noted, after use of either acid or alkaline dentifrice, which could not be attributed to the mechanical stimulation of the brushing.

McClure, F. J., 1939. EFFECT OF FLUORIDES ON SALIVARY AMYLASE. *Publ. Health Rep.*, 54 (48): 2165-2171.

A study was made of the amylolytic power of saliva under the influence of fluorides, and in solutions with a constant pH of approximately 6.6. Concentrations of 0.76, 7.6, 76.0, 760.0 parts/10⁵ of fluoride of NaF, KF, NH_4F , and Na_2SiF_6 had no effect on salivary amylolytic processes; NaF and KF are inert in concentrations up to 3,800 p.p.m. of F. A comparison of school children from two cities revealed that there were no significant differences in the amylolytic action of saliva obtained from those subjects using fluoride-containing (1.8 p.p.m. of F) or fluoride-free drinking water.

McClure, F. J., and F. A. Arnold, 1941. OBSERVATIONS ON INDUCED DENTAL CARIES IN RATS. I. REDUCTION BY FLUORIDES AND IODOACETIC ACID. *Jour. dent. Res.*, 20 (2): 97-105.

The presence of 125 ppm. of fluorine as sodium fluoride in food or water and of 200 ppm. of iodoacetic acid in food with 20 ppm. of iodoacetic acid in water was found to cause a significant reduction in the caries rate of rats fed a caries-producing diet. The possible modes of action of fluorides are discussed. The possibilities include the belief that fluorine may prevent bacterial degradation of carbohydrates in food deposits, may bring about a more acid-resistant tooth material, or may modify the saliva.

McClure, J. F., 1941a. DOMESTIC WATER AND DENTAL CARIES; FLUORINE IN HUMAN SALIVA. *Amer. Jour. Dis. Child.*, 62 (3): 512-515.

An analysis of the fluorine content of paraffin-stimulated saliva is presented. The subjects were both adults and children from various parts of the country where the fluorine in drinking water varied from 0.0 to 4.0 parts per million. No relationship has been established between the fluorine content of drinking water and resulting excretion of fluorine in the saliva.

McClure, F. J., 1941b. DOMESTIC WATER AND DENTAL CARIES III. FLUORINE IN HUMAN SALIVA. *Jour. dental Res.*, 20 (3): 283.

"The saliva samples analyzed consisted of twenty 100 cc. specimens obtained from 10 adults living in Washington, D. C. or vicinity, eleven 100 cc. specimens from 11 children living in Amarillo, Texas, and 16 pooled salivas, representing from 40-200 individuals in each specimen, obtained from school children living in 8 cities in Illinois, 1 city in Ohio, 2 in Arkansas, and 1 in Virginia. Results of saliva analysis indicate that normal saliva contains approximately 0.10 ppm. or less of fluorine. There is some evidence in the data as obtained that domestic use of a communal water containing 3.8-4.0 ppm. of fluorine may increase slightly the fluorine excretion in the saliva. Although drinking waters contain 1.2-1.8 ppm. of fluorine are found associated with unusually low dental caries experience rates, the consumption of these waters caused no corresponding rise in the fluorine content of the saliva as shown by the results thus far obtained." (Complete paper.)

McClure, F. J., and W. L. Hewitt, 1946. THE RELATION OF PENICILLIN TO INDUCED RAT DENTAL CARIES AND ORAL *L. ACIDOPHILUS*. *Jour. dental Res.*, 25 (6): 441-443.

Eighty-two rats, receiving a caries-inducing diet supplemented with 75 U penicillin/g., and water with 75 U/ml., over an average of 118 days, showed a definite inhibition both of *Lactobacillus acidophilus* growth (which was reduced), and caries activity (which was completely absent in the test animals, in contrast to the control rats, 50% of which developed caries). In view of these results, the authors suggest that penicillin therapy may be successfully applied to human dental caries.

McDonald, I. R., and D. A. Denton, 1956. DELAYED EFFECT OF IPSILATERAL INTRACAROTID INFUSION OF SODIUM CHLORIDE ON THE COMPOSITION OF THE PAROTID SALIVA OF SODIUM-DEPLETED SHEEP. *Nature*, 177 (4518): 1035-1036.

Sheep with permanent unilateral parotid fistulae have been shown to undergo sodium depletion with loss of parotid saliva via the fistula. As sodium-depletion increases, the Na/K ratio of the parotid saliva falls from a normal of 18/1 to as low as 1/18. A diet supplement of sodium bicarbonate, sufficient to compensate for the sodium lost in the parotid saliva, restores the Na/K ratio to a normal value; changes in potassium intake do not significantly affect the salivary response to sodium depletion.

Ipsilateral carotid infusion of acetylcholine (1:50,000 in 5 percent dextrose at 0.5 ml./min.) into such sodium-depleted sheep caused an increase in the Na/K ratio to approximately unity, and an immediate sustained parotid salivation which stabilized at 2-4 ml./min. after a 2-4 hour period. Carotid infusion of a 4M sodium chloride solution (200-300 m. equiv. of Na over a 30-40 minute infusion period) caused a small initial rise in the Na content of the saliva while the infusion was being made. After a delay period of 100 to 150 minutes after start of the NaCl infusion a rapid increase in the Na/K ratio of the parotid saliva occurred. In two similar experiments, in which the amount of sodium infused approximately equalled the amount lost in the parotid saliva during the experiment (60 m. equiv.), no delayed change in the Na/K ratio of the saliva was noted. The delayed response following a significant change in the Na balance of the Na-depleted sheep suggests either the action of a specific humoral agent which is produced in response to the infusion, or inhibition of an agent effecting the maintenance of a low Na/K ratio; the return of the Na/K ratio to a normal value is not considered due to a direct effect of the increased Na ions concentration in the parotid blood supply.

McDonald, Ralph E., 1952. THE EFFECT OF ANTI-HISTAMINIC DRUGS ON SALIVARY FLOW AND VISCOSITY. *Jour. dental Res.*, 31 (4): 469.

"Antihistaminics have been found to have action similar to atropine and a parasympathetic blocking effect, in addition to their detoxifying power against histamine. The effect of minimal effective doses of Benadryl, Pyribenzamine, Clor-Trimeton, and Thephorin was observed on the salivary flow and viscosity of 7 adults. After each individual's normal salivary flow and viscosity had been determined, the reaction to each drug was observed over a 5 day period. Benadryl, Pyribenzamine and Clor-Trimeton depressed the salivary flow in all of the subjects. Clor-trimeton exhibited the greatest depressant action, a 25 per cent reduction in flow for the group of subjects. Benadryl and Pyribenzamine each brought about an average 20 per cent reduction in flow for the group. Greatest reduction in flow for any one individual on a given day was 54 per cent for Clor-Trimeton and 50 per cent for Pyribenzamine. Benadryl caused the greatest average increase in viscosity, 8.7 per cent, with some subjects showing as much as a 33 per cent increase. A different reaction to minimal effective doses of Thephorin was noted. The salivary flow was increased an average of 14 per cent in the group, with individual increases as high as 36 per cent. Thephorin reduced salivary viscosity in all but one case; the greatest reduction observed was 15 per cent. Since some of the antihistaminics have been shown to depress salivary flow and increase viscosity, it is possible that

prolonged use of the drugs may depress salivary action and increase the viscosity to the extent that an increase in dental caries as well as other oral manifestations may be noted." (Complete paper.)

McDonald, Ralph E., 1953. THE EFFECT OF ANTI-HISTAMINIC DRUGS ON SALIVARY FLOW AND VISCOSITY. Jour. dent. Res., 32 (2): 224-226.

An investigation was conducted to determine the effect of some of the antihistaminic drugs on the salivary flow and viscosity. Seven adults who were free from any known allergy and had no previous contact with antihistaminics were given benadryl, pyribenzamine, chlortrimeton, and thephorin as the trial drugs. Minimal effective doses of benadryl and pyribenzamine depressed the salivary flow in all cases while chlortrimeton depressed the flow in all but one. All three drugs caused an increase in salivary viscosity. Thephorin increased the salivary flow but reduced viscosity in all but one case. It is suggested that these changes have been brought about through the parasympathetic depressant action of the drugs.

McGeachin, Robert L., and J. R. Gleason, 1956. SALIVARY AMYLASE IN THE RAT. Science, 123 (3202): 841-842.

A quantitative study of amylase levels was conducted in 15 Sprague-Dawley rats fed the usual laboratory diet. The rats, under ether anesthesia, received intraperitoneal injections of 1 mg. /kg. of pilocarpine which permitted collection of 0.3 to 0.5 ml. of saliva in 10-15 minutes. Determinations were made of the amylase levels of saliva and of serum which showed wide variation in rat salivary amylase levels (91,000 to 1,340,000 Van Loon units /100 ml.; average, 626,000 /100 ml.) which were several times greater than levels previously found to occur in human saliva (50,000-2000,000 units /100 ml.). No diastatic-like action of pilocarpine or other interference with the salivary amylase determinations was noted. Little correlation was found between the amylase levels of saliva and that of the serum, which was found to vary in amylase content between 3310 and 4810 units /100 ml. No amylase activity was found in saliva mouth washings of a rat 7 days after surgical removal of its salivary glands; serum levels dropped during this period from a preoperative 2500 to 1800 units. Tests indicated the salivary amylase to be alpha amylase.

McGuigan, Hugh, 1919. THE ACTION OF PTYALIN. Jour. biol. Chem., 39 (2): 273-284.

In vitro tests were performed in order to study the equilibrium establishment of ptyalin-starch reactions. The activity of ptyalin in dilute solutions was found to be directly proportional to the amount of enzyme present. A given amount of the enzyme was demonstrated to cause the production of a similar amount of sugar although the volumes of 1% starch solution were varied. It is postulated that ptyalin possibly unites with starch to exert an initiating force upon starch hydrolysis. Digestion products were observed to interfere with the reaction processes, but maltose and dextrose were not responsible for this effect.

McIntosh, James, W. Warwick James, and P. Lazarus-Barlow, 1924. AN INVESTIGATION INTO THE AETIOLOGY OF DENTAL CARIES. II. THE BIOLOGICAL

CHARACTERISTICS AND DISTRIBUTION OF *B. ACIDOPHILUS ODONTOLYTICUS*. III. FURTHER EXPERIMENTS ON THE PRODUCTION OF ARTIFICIAL CARIES. WITH A NOTE ON THE PRODUCTION OF MALIC ACID BY *B. ACIDOPHILUS ODONTOLYTICUS*. By E. C. Dodds. Brit. Jour. exper. Pathol., 5 (3): 175-183, 2 pl.

The habitat and biochemical characteristics of *B. acidophilus odontolyticus* [*Lactobacillus odontolyticus*] are discussed. In vitro attempts to produce artificial caries by exposing teeth to ordinary broth containing *B. acidophilus odontolyticus* were successful. In vivo attempts at artificial caries production in rabbits failed, but one experiment on a monkey offered some slight evidence of possible success.

McIntosh, James, W. Warwick James, and P. Lazarus-Barlow, 1925. AN INVESTIGATION INTO THE AETIOLOGY OF DENTAL CARIES. IV. ACCESSORY FACTORS IN DENTAL CARIES. (1) REACTION OF THE SALIVA. (2) ACID RESISTANCE OF TEETH. (3) BACTERIOTROPIC ACTION OF SALIVA. Brit. Jour. exper. Pathol., 6 (5): 260-266, 1 pl.

A study of the relation of saliva to dental caries indicated that the salivary secretion in caries-susceptible individuals is generally more acid than that of caries-immunes, and that saliva may contain small quantities of agglutinins for, but has no significant bactericidal effect against *B. acidophilus odontolyticus* [*Lactobacillus odontolyticus*].

McMaster, Paul E., 1939. HUMAN BITE INFECTIONS. Amer. Jour. Surg., 45 (1): 60-65.

A report is presented of 68 cases of lacerations or wounds inflicted by human bites. Smears and cultures made from the infectious discharges of 41 patients revealed the fusiform bacillus, Vincent's spirochete [*Borrelia vincentii*], pus cells, diptheroids, staphylococci - *Staphylococcus aureus* [*Micrococcus pyogenes* var. *aureus*], streptococci - *Streptococcus viridans* [*S. mitis*], and *S. hemolyticus* [*S. pyogenes*], and cellular debris. A few samples yielded no bacterial growths.

In those injuries involving the fists, the dorsal skin of the knuckles tends to retract, seal the wound, and establish anaerobic conditions for the mouth bacteria which have been introduced; the severity of the infection tends to depend upon the anaerobic conditions of Vincent's organisms within the deep tissues.

The course of the infection, treatment, complications, and pathologies of conditions resulting from human bites are also presented.

Mead, Sterling V., 1937. A STUDY OF THE BACTERICIDAL, BACTERIOSTATIC AND PEPTIZING ACTION OF CERTAIN DENTIFRICES. Jour. dental Res., 16 (1): 41-50.

The antibacterial and peptizing actions of sodium ricinoleate and hexylresorcinol were compared with one another and with the cleansing qualities of distilled water rinsings of the mouth.

Three experiments were made on saliva samples of 10 individuals each, by seeding saliva of various dilutions on agar medium. Results showed the growth-inhibitory qualities of sodium ricinoleate to be distinctly more effective than those of hexylresorcinol or water rinsings. The relation of bactericidal qualities of dentifrices to their phenol coefficients is discussed. While the action of sodium ricinoleate was not bactericidal, as

evidenced by its low phenol coefficient, its bacteriostatic action persisted for a considerable period. These properties were in marked contrast to those of hexylresorcinol, which has a high phenol coefficient. The author attributes this phenomenon to a unique cleansing power as well as peptizing action possessed by the sodium ricinoleate, which cleanses the oral tissues to such an extent that little or no organic material remains in the mouth to act as a culture medium for bacteria.

Mead, Sterling V., 1940. A STUDY OF THE COMPARATIVE EFFICIENCY OF BACTERICIDAL AND BACTERIOSTATIC AGENTS IN THE MOUTH. *Amer. Jour. Orthodont. and Oral Surg.*, 26 (10): 968-981.

A discussion and review of the literature is presented on the difficulties encountered in finding a bactericidal or bacteriostatic agent that is effective in sterilizing the oral cavity while being harmless to the oral tissues, the teeth, and the body in general. A study was made of the effect of orange and grapefruit juices on the oral flora and tissues and the results compared with those for hexylresorcinol toothpaste and mouthwash (product A), sodium ricinoleate toothpaste and mouthwash (product B), and a liquid dentifrice containing sodium alkyl sulfate (product C).

Bacteriologic examination was made of the paraffin-stimulated saliva of 9 individuals collected just before lunch, after lunch, just after prophylaxis, and 2 hours later. The predominant types of microorganisms on nutrient agar were staphylococci, streptococci, and Gram-positive diplococci; on tomato agar, long chain streptococci and acid-uric rods were found; on blood agar, alpha and beta hemolytic streptococci, streptococci and a few staphylococci were found.

Products B and C effected the greatest percentage decrease in the number of microorganisms immediately after prophylaxis. However, bacterial counts made 2 hours later showed orange juice and grapefruit juice were more effective in inhibiting further bacterial activity. The average hydrogen-ion concentration of saliva was increased by products A, B, and C but no marked change was noted with orange or grapefruit juice. The citrus fruits temporarily increased the buffer value of saliva. Surface tension measurements showed a marked decrease following the use of products B and C, while orange juice effected no change.

Medak, Herman, and G. W. Burnett, 1953. A STUDY OF VARIOUS METHODS OF COLLECTING HAMSTER SALIVA FOR BACTERIAL COUNTS. *Jour. Dental Res.*, 32 (5): 704.

A comparison of the amounts of hamster saliva collected and of the resultant lactobacilli counts obtained with 4 methods of salivary collection. The methods were: swabbing the oral cavity for one minute and then mechanically shaking the swab for 30 minutes in broth, similar swabbing followed by thorough squeezing of the swab against the wall of the broth tube; collecting saliva from the oral cavity with a medicine dropper, having a 1 mm. diameter opening, until no more saliva could be obtained; similar medicine-dropper collection after pilocarpine stimulation. Weighed saliva samples cultured on Rogosa's medium were collected by each of the 4 methods from 4 groups of 5 adult, caries-free animals on 5 consecutive days. Each experiment was repeated 3 times with additional groups

of animals. Results showed the swabbing-shaking technique to collect the greatest amount of saliva and to obtain the greatest numbers of lactobacilli on the basis either of the amount of saliva collected or of the total unweighed sample. Lactobacilli counts varied up to 100% in each animal from day to day but with less variation between each method of counting. It is suggested that salivary samples must be collected by reproducible and quantitative methods if valid lactobacilli counts are to be obtained. (From author's abstract)

Mediakov, F. S., and S. B. Gurek, 1939. O VLIÎÂNII ATROPINA, ADRENALINA I MORFINA NA RABOTU OKOLOUSHNYKH SLIÛNNYKH ZHELEZ SVINEI [On the influence of atropine, adrenaline and morphine on the work of the parotid glands in pigs]. *Biùll. eksper. Biol. i Med.*, 8 (2): 157-159.

The influence of subcutaneous atropine, adrenaline and morphine injections on the parotid gland of the pig was studied in one bilaterally fistulated animal. The normal secretion in response to 20 gm. of oats was first established.

Injections of 1 cc. of 1% atropine solution produced a cessation of secretion lasting 4 to 4.5 hours. Administration of 1 to 3 mg. of a 1:1000 solution of adrenalin produced no parotid salivation and had no effect on the unconditioned salivary reflex. Administration of 6 cc. of a 1% morphine elicited no parotid salivation, but did decrease reflex salivation up to 50% in response to oats.

Mediakov, F. S., and N. N. Romanov, 1939a. OB USLOVNOREFLEKTORNOM SLIÛNOOTDELENII OKOLOUSHNYKH ZHELEZ SVIN'I [On the conditioned parotid reflex salivation in the pig]. *Biùll. eksper. Biol. Med., Moskva*, 8 (2): 160-162.

Conditioned reflexes were studied in 4 pigs with parotid fistulas, bilateral in 3 of these animals; experiments were made 12 hours after a feeding. The animals were teased for 30 seconds with food, then the reflex consolidated by feeding. The teasing elicited 4 to 5 or more drops of saliva. One pig acquired a conditioned salivary reflex to its placing into the stand; this reflex lasted 8 to 15 minutes and yielded 8.6 to 15 cc. of saliva. In another pig a conditioned reflex was established to the sound of a metronome; the saliva flowed from both the parotid fistulas, and the mouth.

Mediakov, F. S., and S. B. Gurak, 1939b. THE EFFECT OF ATROPINE, ADRENALIN AND MORPHIN ON THE ACTIVITY OF THE PAROTID GLANDS OF THE PIG. *Bull. Biol. Méd. expér. URSS*, 8 (2): 172-174.

English version of Mediakov and Gurak, 1939.

Medjakow, F. S., and N. N. Romanow, 1939c. ÜBER DIE BEDINGTREFLEKTORISCHE SPEICHELSEKRETION DER PAROTISDRÜSEN BEIM SCHWEIN [On the conditioned reflex salivary secretion of the parotid gland in the pig]. *Bull. Biol. Méd. expér. URSS*, 8 (2): 175-177.

German version of Mediakov and Romanov, 1939.

Mednikian, G. A., and Koldovskaiâ, P. M., 1949. IZMENENIE ACTIVNOSTI LIZOZIMA V SLIÛNE POD VLIÎÂNIIUM PATOLOGICHESKIKH PROTSESSOV V ROTOVOI POLOSTI I MATERIALOV, PRIMENIÂMYKH DLIÂ PROTEZIROVANIÎ [Changes in the activity of lysozyme in the saliva under the influence of pathological processes in

the mouth cavity and in the presence of prosthetic materials]. Stomatologiiâ, 4: 46-50.

The influence of various pathological processes, of emotions, and of prosthetic materials was studied in individuals, who were divided into 3 groups: a) with healthy oral mucosa, b) with predominant affection of the mucosa, c) with predominance of diseased teeth. One hundred examinations were made. The lysozyme activity was determined by Ermolova's method (titration and macroscopic determination of the lysis degree of *Microc. lysodeikticus* [*M. lysodeikticus*]): the saliva was diluted in a NaCl solution from 1:10 to 1:40000 and more. To 1 ml. of diluted saliva, 1 ml. of living micrococcus culture was added and left 3 h. at 37° C; the degree of lysis was marked with 1 to 4 crosses. To test the influence of prosthesis material on the lysozyme, plates of gold, steel, or plastic with a determined surface were left in contact with a "normal" saliva (from a healthy mouth) for 24 h. at room temperature, then the culture suspension added.

The titre of lysozyme for the "normal" saliva was found to be 1:640; after dilution of 1:1280 the lysis was incomplete (+++); complete cessation of lysozyme activity was noted after dilution of 1:40000 and more. (According to Skrotskii, Makhlinovskii and Slutskaiia (1937m) the lysozyme titre is somewhat lower.)

In patients with affected oral mucosa (periodontitis, gingivitis), the activity of lysozyme in the saliva was sharply reduced: titre 1:10 or 1:20, and incomplete lysis (+++); complete cessation of lysozyme activity was noted after dilution of the saliva to 1:640, sometimes to 1:1200. A certain decrease in lysozyme activity in relation to the extent and degree of the pathological development was observed.

In cases of dental caries, the lysozyme titre was 1:160; with added gangrene, pulpitis and other deep tissue affections, the lysozyme activity was still lower and the titre reached 1:10, 1:20; the lysis was then ++.

In several patients affected with maxillary osteomyelitis the lysozyme activity was relatively high, approaching that of the normal saliva. (This coincides with the observations of the above-mentioned authors who found a maximal content of lysozyme in the saliva in cases of closed osteomyelitis, which decreased after the rupture of the focus and during convalescence.)

The influence of the emotional factor on lysozyme activity was studied in one woman and in 40 students having healthy mouths. Many tests made under normal circumstances showed a high lysozyme activity in the woman and an average of 1:320 in the students. Tests coinciding with family troubles for the woman, and those made 3 h. to 30 min. before the students' examinations revealed a sharp drop in lysozyme activity to 1:10, with lysis +++. Two to three hours after the examinations the titre had risen to 1:260.

The pH and viscosity of saliva were tested together with lysozyme activity. No definite correlation could be established.

The lysozyme titre in saliva that had been in contact with prosthesis material dropped to 1:10 for plastic, 1:40 for steel, 1:80 for gold, with a lysis reduced to +; the titre of the control being 1:320 and 1:640.

Medvedeva, T. I., 1927. BAKTERIOLOGICHESKOE NABLIUDENIE NAD MIKROFLOROI RTA PRI AL'VEOLIARNOI

PIORREE I IZMENENIE EE POD VLIANIEM LECHENIIÂ PO SPOSOBU ASSISTENTA ODONTOLOGICHESKOI KLINIKI MITROFANOVOI, K. G. [Bacteriologic observations of the microflora of the mouth in pyorrhea alveolaris and its change under the influence of treatment by the method of the Assistant of the Clinic of Odontology, K. G. Mitrofanova.] Meditsinskaia Mysl' Uzbekistana, 1927, October (1): 56-59.

Bacterial examination of smears from patients with pyorrhea alveolaris has shown the varying presence of spirochetes, scattered amoebae, *B. fusiformis* Vincenti [*Fusobacterium plauti-vincenti*], leptothrix, *B. M. buccalis*, and all kinds of rods and cocci. Mechanical treatment (cleansing of teeth and drilling of alveolar cavities) produced no change in the microflora. Chemical treatment (with ac. lacticum, ac. chromicum) reduced the flora only quantitatively. Seeding on different media gave the same cultures. Application of ipecac caused the disappearance of the amoebae, a sharp reduction in the numbers of spirochetes, and a considerable decrease in numbers of leptothrix and cocci. In vitro studies of the flora were made in which minimal quantities of 3, 5, 10 and 12% solutions of ipecac were added to the media over a 7-day period. The 12% solution caused disappearance of all forms except streptococci and staphylococci after 24 hours; after addition of 16 drops ipecac to 1 cc. of the culture media, a considerable reduction in growth of the staphylococci was followed by disappearance of the organism. The streptococci were not killed even after use of 15% or 20% solutions.

Similar experiments were made in vitro to study the action of *B. bulgaricus* [*Lactobacillus bulgaricus*] on streptococci. A one-day old culture of *B. bulgaricus* was used. The result was a striking disappearance of the four types of streptococci.

Mendes de Leon, 1904. ÜBER DIE GEFAHREN DER WUNDINFektion DURCH DAS SPRECHEN BEI OPERATIONEN [On the danger of infecting the wound by talking during surgery]. Arch. klin. Chir., 72 (4): 904-941.

Infective effect of various bacteria, present in the salivary droplet and dispersed in the air through speaking in the operating room, is analyzed. Use of a mask-like saliva collector while performing surgery is advised.

Mendel, Lafayette B., and Frank P. Unterhill, 1907. IS THE SALIVA OF THE DOG AMYLOLYTICALLY ACTIVE? Jour. biol. Chem., 3 (2): 135-1943.

A series of observations were made on dogs and cats to demonstrate amylolytic properties of the saliva.

In anesthetized animals (ether or alcohol-chloroform-ether) saliva was obtained from canulas in the submaxillary ducts following stimulation of the chorda tympani. Gland extracts were also studied. A 1% paste prepared from arrowroot starch was used in the digestion studies, which were carried on in the presence of toluene at 40°C. Amylolysis was noted by applying the iodine test and Fehling's test. The Allihn gravimetric method was used for the quantitative estimations. The reducing power of the solutions is expressed in terms of copper.

The almost uniform failure of dog's saliva to convert starch paste completely to or beyond the dextrin stage leads the authors to conclude

that dog saliva possesses no distinctive amylolytic activity. These findings conflict with those published by Neilson et al., 1906m.

Mendel, Lafayette B., Jessamine Chapman, and Alice F. Blood, 1910. ON THE ADAPTATION OF THE HUMAN SALIVA TO DIET. *Med. Rec.*, 78 (7): 349-351. (Abstr.) *Jour. Amer. med. Assoc.*, 55 (11): 965.

Results of determinations of the amylase content of saliva, using the Wohlgemuth method, suggest that the ptyalin concentration of salivary secretions does not appreciably increase after a prolonged diet, rich in carbohydrates and lacking in meats.

Mendel, Joseph, 1916. MODES DE REACTION PHAGOCYTAIRE DANS LA CAVITE BUCCALE DE L'HOMME [Manner of the phagocytic reaction in the oral cavity of man]. *Compt. rend. de la Soc. de Biol. (Paris)*, 79 (17): 925-928.

In the normal healthy state, the gingival crevice is closed and phagocytic activity is low with 5-7 phagocytes per 100 white corpuscles. Infection of the crevice raises the count to 60 or 80 per 100. In true pyorrhea alveolaris, the phagocytic power is ordinarily reduced (9 to 23 phagocytes per 100), while it is very active if the infection is at discrete points and localized.

Leucocytosis, hyperleucocytosis and pyorrhea alveolaris can be considered as three modes of oral reaction to infectious agents. In the normal state the gum is an effective barrier and the gingival exudate is characterized by leukocytosis and feeble phagocytic activity. When the pericervical fibrous ring is broken through, leukocytosis is changed to hyperleucocytosis and phagocytic action is vigorous. Pyorrhea alveolaris indicates a breakdown of oral defenses, and in all probability of defenses of the organism in general.

Mestrezat, W., 1907. ORIGINE PHYSIOLOGIQUE DU POUVOIR SACCHARIFIANT DE LA SALIVE [Physiological origin of the saccharifying power of saliva]. *Compt. rend. de la Soc. de Biol. (Paris)*, 63 (38): 736-738.

Experiments to explain the amylolytic activity of human saliva were made using sterile technique to eliminate the presence of bacteria as a possible source of this activity.

Pure parotid saliva was shown to be more active than submaxillary saliva, while a mixture of the two gave intermediate results. Ptyalin could be isolated from both the parotid and submaxillary salivas. Buccal saliva had practically an identical action to that of the mixed saliva. The author concludes this amylolytic activity of saliva to be glandular in origin.

Mestrezat, W., and M. Lisbonne, 1909. LE SUCRE EXISTE-T-IL DANS LA SALIVE DU CHAT? [Is sugar present in the saliva of the cat?]. *Compt. rend. de la Soc. de Biol. (Paris)*, 66 (18): 835-837.

Saliva from the submaxillary gland of the cat under chloralose anesthesia was found to contain no sugar. This saliva resembled normal submaxillary saliva and mixed saliva obtained from cats at the beginning of ether anesthesia; in later stages of ether anesthesia, sugar appears in the saliva.

Meyer, Jacob, J. S. Golden, N. Steiner, and H. Necheles, 1937. THE PTYALIN CONTENT OF HUMAN

SALIVA IN OLD AGE. *Amer. Jour. Physiol.*, 119 (3): 600-602.

The salivas of 27 elderly men and women (69-100 years of age) and of 12 younger persons who served as controls (21-31 years) were examined for ptyalin content by the method of Hawk and Bergeim.

In basal [unstimulated] salivary secretions, the ptyalin content in the younger group ranged from 2.4 to 22.2 units of ptyalin per cc. saliva (average, 10.15); in the older group, the range was from 0.19 to 0.48 (average, 0.303).

When salivary flow was stimulated (chewing gum), the flow in the younger group ranged from 13.6 to 15.0 cc. (average, 14.2 cc.) in the course of the experiment (30 minutes or less), while that in the older group was from 1.5 to 15.0 cc. (average, 5.8 cc.). The ptyalin content ranged from 2.0 to 14.3 units (8.2 average) in the younger group and from 0.18 to 0.42 units (0.28 average) in the older group. The specific gravity of saliva of the younger group was 1.009; that of the older, 1.004.

Meyer, Jacob, and Heinrich Necheles, 1940. STUDIES IN OLD AGE. IV. THE CLINICAL SIGNIFICANCE OF SALIVARY, GASTRIC AND PANCREATIC SECRETION IN THE AGED. *Jour. Amer. med. Assoc.*, 115 (24): 2050-2053.

Basal (fasting) and stimulated (chewing) saliva samples of 32 persons, 12 to 60 years of age, and of 29 persons 60-90 years, were analyzed for ptyalin content. A graphing of the values (cf. Chart I, p. 2051) indicates a general depression of the conversion of carbohydrates by salivary amylase in the aged.

Studies of the gastric and pancreatic enzymes (i.e., pepsin and pancreatic amylase) indicate that the "carbohydrate digestion is probably completed in the intestinal tract and that the pancreatic amylase is a substitute for the salivary amylase."

The dried tongue in aged persons is attributed by the authors to a decrease in salivary secretion, but the importance of differentiating the dry tongue due to metabolic disturbances from that due to pathological factors is stressed.

Meyer, Karl, and E. Hannel, 1946. LYSOZYME AS A MUCOLYTIC ENZYME. *Federation Proc. (Fed. Amer. Soc. exper. Biol.)*, Baltimore, 5 (1) Part II: 147-148.

Results are presented of an assay method for lysozyme activity which is based on the depolymerization of the viscosimetrically measured substrate; the viscosity of the solution containing the substrate is reduced to half by pure lysozyme in ten minutes. By this method, it was determined that saliva contains 500 times less lysozyme than tears; lysozyme-like enzymes also occur in two plant proteases.

Meyer, Kurt H., Ed. H. Fischer, A. Staub, and P. Bernfeld, 1948. SUR LES ENZYMES AMYLOLYTIQUES. ISOLEMENT ET CRISTALLISATION DE L' α -AMYLASE DE SALIVE HUMAINE [On amylolytic enzymes. Isolation and crystallization of the α -amylase of human saliva]. *Helvet. chim. Acta*, 31 (7): 2158-2164.

The procedure for the purification and crystallization of α -amylase of human saliva is described in detail.

Human saliva was reduced to 1/8 of its volume and, after 3 successive recrystallizations, the mother-liquor and the crystals showed the same

degree of purity. In electrophoresis, the crystallized enzyme behaved like a homogeneous substance; the authors conclude this enzyme should be considered as the α -amylase of human saliva.

Michaelis, J. P., 1900. ON SIALO-SEMEIOLOGY: ANALYSIS OF THE SALIVA AS AN AID IN THE DIAGNOSIS OF DIATHETIC DISEASES AND GINGIVO-DENTAL CHANGES. Dental Cosmos, 42 (12): 1293-1297.

The salivas of normal persons as well as those with hypoacid and hyperacid diathesis were examined to study the changes in composition that occur in relation to pathological states. Saliva is considered to contain every soluble and crystallizable principle which is found in excess in the blood plasma and which is dialyzable through the salivary glands. Analysis of the saliva provides a means of diagnosis of diathetic states.

Michaelis, L., and H. Pechstein, 1914. DIE WIRKUNGSBEDINGUNGEN DER SPEICHELDIASE [The conditions of action of salivary diastase]. Biochem. Zeitschr. 59 (1-2): 77-99.

Experiments were conducted with human saliva of 1%-10% concentration. The affinity of diastase to salts, starches, anions and complex compounds is discussed in detail.

Michel, A., 1909. DIE MUNDFLÜSSIGKEIT UND IHR EINFLUSS AUF DIE IN DER MUNDHÖHLE ABLAUFENDEN PATHOLOGISCHEN VORGÄNGE [Saliva and its influence on pathological processes in the oral cavity]. Deutsche Zahnheilk. in Vorträgen, 1909 (10): 3-53.

An extensive discussion of the physical and chemical properties of saliva, including microbial flora. 44 refs.

Mikhelson, M. G., 1937. THE INTERRELATION BETWEEN NERVOUS AND HUMORAL STIMULI OF THE SALIVARY GLANDS. COMMUNICATION I. SYMPATHETIC INFLUENCES UPON PARASYMPATHETIC SECRETION OF SALIVARY GLANDS OF THE DOG. Bull. Biol. Méd. expér. URSS, 4 (2): 88-91.

The effects of sympathetic stimulation and of adrenalin on parasympathetic-stimulated salivary glands were studied in 58 experiments in dogs under luminal narcosis. Salivation from the cannulated submaxillary and parotid glands was registered using an electric drop recorder; arterial blood pressure, and venous blood flow from the glands were determined during the tests. Parasympathetic stimulation to the glands included faradic stimulation of the chorda, intravenous injection of 0.1-0.5 mg./kg. of pilocarpine hydrochloride, or intra-arterial injection of 1 mg. of eserine into the submaxillary gland.

Faradic stimulation of either the cervical sympathetic stem or of the peripheral end of the splanchnic nerve at the suprarenal gland, or intravenous injection of adrenalin were found to inhibit parasympathetic secretion, the inhibitions increasing in degree and in duration with increase in strength of the faradic stimulation or in amount of the adrenalin injected. On decrease of parasympathetic secretion, sympathetic stimulation produced a short initial increase in salivation, followed by an inhibition phase before a secondary more prolonged increase in salivation.

With further slackening of parasympathetic secretion, sympathetic stimulation produced only

a considerable (up to 10-fold) and prolonged (up to 5 minutes) increase in salivation. This increase is more pronounced in glands subject to prolonged stimulation than in non-fatigued glands, the secretion being equally low in both cases.

Observations were made on the third day after severance of the vagosympathetic stem when the vasoconstricting sympathetic fibers had degenerated and the secretory fibers were still efficient. Under such conditions both stimulation of the parasympathetic nerve and injection of adrenalin caused marked inhibition of the abundant parasympathetic secretion without reducing venous blood flow from the gland. The sympathetic effects are not considered due to vascular changes although these changes and glandular secretion may be associated.

Sympathetic salivation in the dog is determined by the functional state and activity level of the peripheral secretory apparatus. The sympathetic nerve, on repeated or prolonged stimulation, loses its capacity to influence salivation whereas the sialogogic effects of adrenalin are not noticeably affected by repetition.

Salivation, induced by small amounts of pilocarpine, is usually increased by chordal stimulation; this enhancement of secretion is less pronounced with larger doses of pilocarpine. When pilocarpine secretion has approached its maximum level, chordal stimulation usually does not effect salivation; inhibition of the pilocarpine salivation is occasionally noted. The difficulty in obtaining chordal inhibition of pilocarpine salivation under this condition is attributed to a paralysis of the chordal end-apparatus effected by the large doses of pilocarpine.

Mikhelson, M. IA., 1938. VZAIMOOTNOSHENIIA NERVNYKH I GUMORAL'NYKH RAZKRAZHITELEI SLIUNNYKH ZHELEZ. SOOBSHCHENIE I. SIMPATICHESKOE VLIYANIE NA PARASIMPATICHESKUIIN SEKRETSIIU SLIUNNY KH ZHELEZ SOBAKI [The relationship of nervous and humoral stimulants of the salivary glands. Communication I. Sympathetic influence on the parasympathetic secretion of the salivary glands in the dog]. Fiziol. Zhur., 25 (6): 842-855.

The influence of the sympathetic nerve and humoral stimulants during prolonged salivary secretion and their relationship to the glandular blood supply was studied in 58 dogs under conditions of severe experimentation. The dogs were fed 0.12 to 0.15 mg./kg. of luminal on an empty stomach, on the eve of the experiment. Immersion electrodes were placed on the peripheral section of the lingual nerve before the branching of the chord, or directly on the chorda. Jacobsen's nerve was stimulated in the stem of n. auricula temporalis, when necessary. Wharton and Stensen's ducts were cannulated. The sympathetic nerve was separated from the vagus at the level of the upper neck ganglion and placed on electrodes. The glandular blood supply was calculated by means of its venous outflow. All the veins arriving at the external jugular were cut with the exception of the submaxillary. The exterior jugular vein was then resected and its distal end placed into a Veselkin-Kartashevskii cannula connected with an electrical device for registering the blood drops through a water-air medium. The continuous loss of blood was compensated by intravenous injection of Locke's solution, to permit the experiment to last 12 to 14 hours. For the injection of drugs

into the submaxillary gland a small cannula was attached at one of the branches of the exterior submaxillary artery. All the other branches of a maxillaria ext. were cut. The electrical stimulation of the nerves was done by the Du Bois-Reymond apparatus from a 4-volt accumulator (frequency 35/sec.).

1. In a first series of experiments, 0.1 to 0.5 mg./kg. pilocarpine hydrochloride was used to elicit a prolonged parasympathetic salivation.

In experiments on the submaxillary glands, without the pilocarpine injection, a 1 to 2 cm. above-threshold stimulation of the sympathetic nerve elicited 1 to 2 drops of saliva; after injection of 1 to 3 mg./kg. pilocarpine, sympathetic stimulation produced variable results depending on the condition of the gland. During rapid secretion, a 2 to 4 cm. above-threshold sympathetic stimulation inhibited or completely blocked the salivation. The inhibiting effect increased in proportion to the stimulation and could arrest the secretion for several minutes. If the sympathetic stimulation preceded the pilocarpine injection, it could retard salivation several minutes. At the slowing down of pilocarpine secretion, sympathetic stimulation resulted in a short, initial increase in secretion usually preceding a period of inhibition, which was followed by a phase of more prolonged and increased secretion. The slower the pilocarpine salivation, the more preponderant becomes the third phase of sympathetic stimulation, until the inhibiting effect disappears completely. The increase is very pronounced and dozens of drops of saliva are secreted. Intravenous injection of 0.001 to 0.1 mg. adrenalin hydrochloride during pilocarpine secretion produced exactly the same results as sympathetic stimulation.

An analogous series of experiments were then conducted with chordal stimulation. Salivation lasting several hours was obtained by an intermittent or a continuous application of faradic current of 1 cm. above-threshold strength. The results obtained with sympathetic or adrenalin stimulation completely coincided with those found for pilocarpine salivation. Parallel experiments were also made with injection into the submaxillary artery of 1 mg. eserine salicylate which elicited a 1.5 hour salivation. The results obtained after sympathetic or adrenalin stimulation coincided with those for pilocarpine salivation.

In analogous experiments on the parotid glands, Jacobsen's nerve was cut in the trunk of the auriculo-temporal and the peripheral section of the nerve fixed on immersion electrodes. For comparison, the submaxillary and parotid secretions were measured simultaneously. The results showed a complete parallelism between these two glands, though the parotid effects were quantitatively smaller; energetic parasympathetic secretion could be inhibited with difficulty through sympathetic stimulation, but easily through adrenalin.

The vascular reaction was studied in 40 cases. The majority of experiments showed no correlation between the short initial increase in salivation, effected by sympathetic or adrenalin stimulation, and the vascular reaction. The author explains the initial salivation as a result of a contraction of the muscular elements of the gland which expels the secretion. The inhibition phase corresponds in the majority of cases to a constriction of the glandular vessels, as shown by the

decrease in venous outflow; the third phase of increased secretion, to an increase in venous outflow. The vascular reaction may slightly precede the secretory. (These results confirm Langley's view, 1878). There are a great number of cases, however, which show no trace of corresponding vascular reaction to very pronounced three-phased sympathetic effects, or a corresponding vascular reaction in the second phase may not be followed by any change in the third. This situation is the same for chordal as for pilocarpine saliva.

Impeding arterial supply to the gland considerably slowed down the secretion. However, this retardation proceeds gradually, while sympathetic inhibition stops the secretion several seconds after stimulation.

The author believes that, while there is participation by vascular elements in the secretory changes, secretory increase or inhibition is not due to the vascular reaction alone. The cases of non-correspondence show that the above-mentioned secretory effects can take place through direct sympathetic or adrenalin action on the glands, without vascular reaction, as the author's experiments with degeneration of sympathetic fibers (method of Sinelnikov) have shown; sympathetic and adrenalin stimulation produced a pronounced inhibition or secretion without vasoconstriction. Sensitization of the salivary glands to sympathetic action through cocaine (Cannon, Bacq) leads to a considerable increase and prolongation of both the secretory and vascular reaction. If the majority of the author's experiments confirmed Langley's data of the coincidence of the vasoconstricting effect of sympathetic stimulation and secretory inhibition, in a number of experiments, especially in the case of preliminary sympathetic resection, a very pronounced inhibition and even cessation of pilocarpine secretion was noticed without any vasoconstricting effect on the salivary gland. Therefore, the sympathetic inhibition of salivation is not determined by the vascular effect, though it may be accompanied by it. The same sympathetic action, depending on the condition of the gland and, in particular, of its end apparatus, induces either inhibition or increased secretion, i.e. the effect of sympathetic influence (nervous or humoral) on salivary secretion is determined by the functional state and activity level of the peripheral secretory apparatus. The sympathetic action changes the glandular reaction to its parasympathetic stimulant. Sympathetic stimulation of a parasympathetically-stimulated and energetically-secreting gland inhibits secretion either directly or by desensitizing the parasympathetic nervous endings toward their stimulant. Sympathetic stimulation of a weakly-stimulated gland may increase the sensitivity of the neuro-glandular apparatus toward the continued parasympathetic stimulation, thus increasing parasympathetic secretion. This enhancing effect cannot be attributed to a vascular reaction, since the increase flow may be accompanied by vasoconstriction. If the parasympathetic stimulation is subliminal, sympathetic intervention may result in very strong secretory reaction. The fact that saliva, collected during this augmented secretion, resembles the chemical composition of parasympathetic saliva suggests that this secretion may be due to sensitization of the gland toward the low parasympathetic stimulation, which activated the subliminal stimulation.

In the salivary glands, small doses of the sympathetic and parasympathetic substances (adrenalin-like, and acetylcholine) do not react as antagonists, but as synergists. The formation of acetylcholine in the gland cells, under the influence of small doses of adrenalin, stimulates a strong secretion, not attributable to adrenalin alone.

Mikhelson, M. IA., 1938a. O VOZMOZHNOСТИ KORKOVOI REGULIATSII PRONITSAEMOSTI ZHELEZISTOI TKANI [On the possibility of cortical regulation of glandular tissue permeability]. Fiziol. Zhurn. 25 (6): 857-863.

The influence of cortical impulses upon the permeability of glandular tissue for potassium iodide introduced into the organism was studied in dogs under conditions of chronical experiment. In three dogs with fistulae of the parotid duct conditioned reflexes were previously established.

One to two hours after 0.5 g. of potassium iodide has been given by mouth, the iodine in the saliva increases to 0.20 or 0.25 mg./cc. of saliva and remains steady at this level for 6 to 12 hours, provided that the unconditioned salivary secretion is maintained by periodical feeding with meat-biscuit powder or by the injection of pilocarpine. In rapid secretion, the concentration of iodine in the saliva decreases, the first samples being always richer in iodine than the following. The concentration increases with the length of the interval between periods of secretion.

Impulses originated in the cerebral cortex by the action of food-conditioned stimuli distinctly alter the tissue permeability of the salivary glands for the iodine salts circulating in the blood.

The cortical impulses which stimulate or inhibit the salivary secretion alter the tissue permeability of salivary glands in the reverse direction. The excitatory impulse leads to the decrease of permeability while the inhibitory impulse increases it.

Miller, W. D. 1887. UEBER DEN JETZIGEN STAND UNSERER KENNTNISSE DER PARASITAREN KRANKHEITEN DER MUNDHÖHLE UND DER ZÄHNE [On the present status of our knowledge of parasitic diseases of the mouth cavity and the teeth]. Centralbl. f. Bakteriologie, 1 (2): 47-49.

A limited discussion is presented of the etiology of dental caries which is attributed to a saliva acidity-organism theory. The author states that 50 varieties of yeast [not identified] have been isolated from the oral cavity.

Miller, Benjamin F., and J. A. Muntz, 1938. A METHOD FOR THE ESTIMATION OF ULTRAMICRO-QUANTITIES OF LACTIC ACID. Jour. biol. Chem., 126 (1): 413-421.

A quantitative method is described for the determination of lactic acid, in amounts as small as 0.1 microgram, in serum, saliva, and teeth and carious material. The procedure is based upon the sensitive color reaction of Eegriwe (Zeitschr. analyt. Chem., 95: 323, 1933) and employs hot, concentrated sulfuric acid to oxidized lactic acid to acetaldehyde which in turn, reacts with p-hydroxydiphenyl to yield an intense bluish-violet color. The method's range of optimum sensitivity lies between 2 and 10 micrograms of determinable lactate.

Miller, W. D., 1891. THE HUMAN MOUTH AS A FOCUS OF INFECTION. III. PROPHYLAXIS. Dental Cosmos, 33 (11): 913-919.

In tests of antiseptic solutions on oral bacteria, a mixture of sublimate and benzoic acid which completely sterilized a pure culture of streptococci in one minute required at least 5 times as long to sterilize an equal quantity of saliva. Solutions of saccharin and/or benzoic acid were found to be the most practical of a variety of antiseptic mouth washes tested by incubating mouth rinses. Addition of hydrogen peroxide to the mouth wash appeared to intensify the effect of the antiseptic. In a third series of 15 tests the saliva of persons harboring pathogenic oral bacteria collected before and 15 minutes after rinsing the mouth with an antiseptic solution was injected peritoneally into mice. A saccharin solution (10% saturated alcoholic solution in water) with or without addition of H₂O₂ was found to prevent infection due to micrococcus of sputum septicemia [*Diplococcus pneumoniae*] and to retard but not prevent death of the mice due to the action of oral pyogenic bacteria or the "bacillus of sputum septicemia."

Miller, W. D., 1902. THE PRESENCE OF BACTERIAL PLAQUES ON THE SURFACE OF THE TEETH, AND THEIR SIGNIFICANCE. Dental Cosmos, 44 (5): 425-446.

Thin ground sections of teeth (human, dog, warthog, and gorilla) were treated with dilute acids to study the bacterial surface film. As soon as the acid came in contact with the section, the film was seen to separate from the surface of the enamel. The author considers this to indicate that the film was primarily a growth of bacteria in or on the enamel cuticle with the exception of some cases of decay where a slight attachment of the film to the enamel itself was noted. Staining whole washed teeth with eosin or Gram stain showed the bacterial film to be present independent of the presence of the enamel cuticle. The film was observed on all teeth that were not free of deposits of mucus, epithelium, food, etc.

Miller, W. D., 1903. INTRODUCTION TO THE STUDY OF IMMUNITY IN ITS RELATION TO THE DISEASES OF THE MOUTH AND TEETH. Dental Cosmos, 45 (1): 1-12.

Human saliva, filtered through a Chamberland filter and diluted with varying amounts of a nutrient broth, was seeded with bacteria from decaying dentin. No retardation in growth was noted in media containing 50%, 80%, and 90% filtered saliva over that observed in aqueous control media. In another test, grape sugar and peptone were added to the saliva prior to filtration, then the media seeded with *Bacillus prodigiosus* [*Serratia marcescens*]. Bacterial growth took place to a much greater extent than in identically treated aqueous-media controls. Similar results were obtained in an experiment in which the saliva was reduced to half its volume over a water bath.

In a second series of experiments saliva either non-filtered or filtered through filter paper was used. Numbers of bacteria increased greatly in paper-filtered saliva whether or not it contained added nutrients and whether or not the saliva came from a caries-resistant person. Results were similar whether the media were seeded with normal oral bacteria or non-oral organisms. Saliva, with or without addition of

sugar and peptone, was incubated after filtration through filter-paper. Numbers of bacteria in the saliva increased after a temporary lag. Saliva evaporated at body temperature did not differ in antibacterial properties from that heated at higher temperatures.

Addition of potassium thiocyanide to saliva in concentrations of 1:5000 to 1:250 in addition to peptone and carbohydrates showed no retarding effects on bacteria from dental caries for concentrations of less than 1:1000. This material had no great effect on growth of *Serratia marcescens* when this organism was used in place of the oral bacteria.

To compare fermentation results in the mouth and in the incubator, a denture with holes prepared for food was placed in the mouth and another in a moist chamber incubator overnight. Tests of the contents the following morning showed that the contents of the cavity opening into the mouth had a less acid reaction, especially the superficial layers, than those of the cavity left in the incubator. This difference was attributed to the dilution effect of saliva. A similar experiment using little linen bags filled with food and tied to the teeth overnight had a markedly weaker acid reaction than similar bags suspended in flasks in the incubator.

Miller, W. D., 1903a. INTRODUCTION TO THE STUDY OF IMMUNITY IN ITS RELATION TO THE DISEASES OF THE MOUTH AND TEETH. Dental Cosmos, 45 (2): 85-94.

The antiseptic action of mucus was compared to that of saliva of the same person. The mucus collected in the Chamberland filter after filtration of 30 c.c. of saliva, tested at the end of 24 and 48 hours, showed greater acid production and thus greater bacterial activity than clear unfiltered saliva of the same person. Buccal mucus even of a person immune to caries showed no antibacterial action when tested on *Bacillus prodigiosus* [*Serratia marcescens*].

A comparison of the fermentation rate of saliva of persons susceptible or immune to dental caries was made using 5 c.c. samples of saliva with peptone and carbohydrate added. The saliva of the immune persons, as a rule, produced less acid by fermentation, especially during the first 24 hours of incubation.

In an experiment to test for the possible presence of alexins in the saliva, 3 tubes were prepared with paper-filtered saliva. Two of these were kept at 55°-60°C for 1/2 hour, then 3 drops of fresh saliva were added to one of the heated tubes prior to seeding all three with *Bacillus prodigiosus*. Contrary to expectations, a less rapid development of bacteria took place in the heated, untreated saliva than in the unheated control or the reactivated saliva.

A test was performed using fresh saliva with and without addition of 2% grape sugar and pepton, seeded with *B. prodigiosus*. The saliva containing added nutrient showed a greater abundance of bacterial growth with more rapid disappearance of the introduced organism than the untreated saliva. *B. prodigiosus* tended to persist for longer periods when seeding was heavier or the experiment was conducted at room temperature. The effect of the presence of the normal oral flora on *B. prodigiosus* was further tested by flushing the mouth with a heavy culture of organism. Tests of the

saliva showed complete disappearance of the introduced organism 6 hours later.

Miller, W. D., 1903b. FURTHER EXPERIMENTS RELATING TO THE QUESTION OF IMMUNITY. Dental Cosmos, 45 (9): 689-698.

Fresh rabbit blood was shaken briskly with glass beads and centrifuged. Five drops of red blood corpuscles thus obtained were placed in each of a number of sterilized tubes with addition of 2 to 5 cc. of various substances being tested for hemolytic action. Fresh, "old," and filtered saliva, as well as saliva heated to 60°C., and boiled saliva caused immediate and total solution of the corpuscles. As tap or distilled water and weak solutions of various salts found in saliva accomplished the same results, the hemolytic action was attributed to the water in all cases. Saliva, to which 0.75% of NaCl had been added to raise it to the salinity of blood was tested for the presence of hemolytic bodies analogous to alexins of the blood. This saliva was found to have lost its hemolytic power almost completely.

In an investigation of the role of phagocytosis in the human mouth, secretions from wounds produced by extractions 3 to 4 hours earlier were found to contain vast numbers of leukocytes. These were loaded with bacteria in many cases.

To test possible antiseptic action of saliva, 3 or 4 loops of blood from a mouse dead from *Diplococcus pneumoniae*, were placed in 1 cc. of the author's saliva which had been filtered through 2 layers of common filter paper. This and a similar suspension using sterilized water in place of the saliva were permitted to stand for 2 or 3 hours and were then injected subcutaneously into mice. In 2/3rds of the mice those which received pneumococci in saliva died sooner. It is concluded that virulence is retained by the organism at least as well in saliva as in water.

Bacterial counts in saliva from persons immune, slightly, moderately, or highly susceptible to caries gave no significant results as to favorability of mouths to development of bacteria. Perforated celluloid capsules filled with bread and tied to the teeth in the mouth overnight gave an acid reaction to litmus for both a person immune to caries and one moderately susceptible. No relation was found between viscosity or quantity of saliva produced and caries. From experiments designed to detect the presence of fermentable carbohydrates secreted by the salivary glands in saliva, the author concludes that none occurred under normal circumstances in sufficient quantity to materially influence caries.

In experiments comparing the susceptibility of dentin of different teeth to decalcification, plates of hard and soft ivory, as well as dentin from the walrus and sperm whale were suspended in sugar-saliva, sugar saliva-bouillon, and sugar saliva-bouillon lactic acid solutions. Results indicated an increase in susceptibility to softening that was directly related to decrease in density and calcium salt content of the dentin.

Miller, W. D., 1904. A STUDY OF CERTAIN QUESTIONS RELATING TO THE PATHOLOGY OF THE TEETH. Dental Cosmos, 46 (12): 981-1001.

In a study of oral environmental factors tests were made of bacterial growth and acid production in acid and alkaline media composed of saliva and

masticated foodstuffs. Alkaline media, infected with saliva, showed a greater proliferation of bacteria and rapidly became as acidic as the acid media. Two periods of growth were noted in the alkaline media. A study of plaques on teeth placed in the saliva-foodstuff media showed the bacterial film either to have no effect on decalcification, or to protect the tooth surface. Tartar deposits were seen to afford protection to the tooth surface from bacterial acids until the tartar was dissolved by the acids. Differences in degree of hardness of various types of dentin placed in the same media were correlated with degree of resistance to decalcification.

Miller, W. D., 1905. A STUDY OF CERTAIN QUESTIONS RELATING TO THE PATHOLOGY OF THE TEETH. *Dental Cosmos*, 47 (1): 18-39.

Ground lamellae of teeth were subjected to the acid action of fermenting solutions as well as to mixtures of saliva and foodstuffs in experiments varying in length from 2 months to one year and 9 months. An enamel cuticle which adheres tenaciously to the enamel surface, as well as a thin outer layer or crust of the enamel showed great resistance to attacking agents. These appeared to gain entrance to the more susceptible dentin through natural or acquired defects in the enamel surface. Resistance of the enamel varied in different teeth and within different parts of the same tooth.

Miller, W. D., 1905a. NEW THEORIES CONCERNING DECAY OF TEETH. *Dental Cosmos*, 47 (11): 1293-1301.

Solutions of various acids in watery and very viscid saliva tested for decalcification of dentin showed no accelerated action attributable to the mucin content of the saliva. Other experiments using prepared ox mucin or mucin precipitated from saliva had no appreciable decalcifying action on dentin. The author concludes that the decalcifying action of weak acids is not increased by the addition of mucin.

Miller, W. D., 1907. EXPERIMENTS AND OBSERVATIONS ON THE WASTING OF TOOTH TISSUE VARIOUSLY DESIGNATED AS EROSION, ABRASION, CHEMICAL ABRASION, DENUDATION, ETC. [I.] *Dental Cosmos*, 49 (1): 1-23

Saliva is considered to have a negligible mechanical effect on the dental tissue in the absence of appreciable quantities of gritty substances.

Miller, W. D., 1907a. EXPERIMENTS AND OBSERVATIONS ON THE WASTING OF TOOTH TISSUE VARIOUSLY DESIGNATED AS EROSION, ABRASION, CHEMICAL ABRASION, DENUDATION, ETC. II. *Dental Cosmos*, 49 (2): 109-124.

Experiments were carried out on the effects of various mechanical agents and chemical substances on human teeth. The author concludes that while an acid condition may accelerate the progress of wasting of dental tissue, the mere fact that litmus paper indicates saliva to have an acid reaction does not justify the conclusion that the cause of the wasting has been found.

Miller, W. D., 1907b. EXPERIMENTS AND OBSERVATIONS ON THE WASTING OF TOOTH TISSUE VARIOUSLY DESIGNATED AS EROSION, ABRASION, CHEMICAL ABRASION, DENUDATION, ETC. III. *Dental Cosmos*, 49 (3): 225-247.

Investigation of the relation between wasting of tooth tissue and acid reaction of saliva showed that variation in pH occurred at different times of the day, but the reaction was predominantly alkaline. The acid reaction of mucus from the labial glands found in 50% of 52 cases was considered as possibly due to acid sodium phosphate or mucin. The author assumes that the mere power of the mucus or saliva to redden blue litmus does not necessarily indicate a particularly deleterious action of mucus on the teeth.

Miller, W. D., 1907c. FURTHER INVESTIGATIONS ON THE SUBJECT OF WASTING. *Dental Cosmos*, 49 (7): 677-689.

A series of experiments indicated that addition of dibasic sodium phosphate to either aqueous or salivary solutions of acid calcium or sodium phosphate prevented decalcification of human teeth.

Mislawsky, N. and Smirnow, 1895. RECHERCHES SUR LA SÉCRÉTION SALIVAIRE [Research on salivary secretion]. *Compt. rend. de la Soc. de Biol.* (Paris), 47 (24): 536-537.

A morphological study of changes in the epithelial cells of salivary ducts was made on dogs starved for 24 hours.

Secretion of the salivary glands induced by excitation of the auriculotemporal nerve, with and without cutting of the cervical sympathetic nerve, caused modifications in the size and disposition of the granular content of the cells.

Moëller, Alfred, 1899. ZUR VERBREITUNGSWEISE DER TUBERKELPILZE [On the mode of transmission of tubercle bacilli]. *Zeitschr. f. Hyg. u. Infektionskrankh.*, 32 (2): 205-213.

Culture plates exposed within 1 m. of the mouths of 30 tuberculous patients showed that 16 of the patients expelled tubercle bacilli-bearing droplets. The droplets, which originated primarily from sputum rather than from saliva, were expelled in greater numbers in the mornings and evenings than at other periods of the day.

Of twelve guinea pigs exposed within 25-30 cm. of the mouths of coughing tuberculous patients, only two animals succumbed to typical tuberculosis.

Moldavskaia, E. A., 1928. DEIATEL'NOST' SLIŪN-NYKH ZHELEZ SOBARI PRI BEZUSLOVNOI I USLOVNOI TEPLOVYKH REFLEKSAXH [The activity of the salivary glands in the dog during conditioned and unconditioned heat reflexes]. *Fiziol. Zhurn.*, SSSR, 11 (5): 393-411.

Salivary secretion in unconditioned or conditioned heat reflexes was studied in three dogs, operated upon by the Glinskii method, two with submaxillary, one with parotid and submaxillary fistulae. The animals were placed in individual boxes heated to 45 or 63°C, head and forelegs protruding; 50 salivary samples of 1.4 to 1.6 cc. were collected during unconditioned, and 50 during conditioned reflexes, and examined for dry residue, organic matter and ash. The heat reflex consisted in accelerated breathing, decrease in body temperature and salivation. A conditioned heat reflex developed easily and was very stable. Two parallel studies were therefore made: first, the conditioned heat salivation (without heat) was tested, then the unconditioned.

Experiments are detailed in 8 tables. They showed that the unconditioned heat-stimulated saliva of the submaxillary glands is 2 to 3 times poorer in dry residue than the normal, food-stimulated saliva. In the parotid gland this proportion is less evident, although its lower dry residue content is very marked. The viscosity of both salivas is very low, the ash content is increased. (These results coincide with the findings of Porfenov, 1906).

Salivary secretion during the conditioned heat reflex is considerably slower than in the unconditioned, its dry residue amount, however, is greater in both the parotid and the submaxillary gland (which contradicts the findings of Vulfson, 1898, and Selgeim, 1904); the viscosity is the same as in the unconditioned; the ash content is equally increased.

The author repeated the experiments done by Vulfson and Sel'geim. Unconditioned saliva was elicited by crushed rusks or powdered meat and rusks, and the conditioned reflex produced by teasing with the same food. The results obtained coincided with those of Vulfson and Sel'geim, i.e. the conditioned saliva was poorer in dry residue than the unconditioned.

During the first days of experimentation, one of the dogs went through a period of nervousness preceding the heat reflexes, which was also accompanied by salivation. The saliva secreted resembled the heat-stimulated saliva; it was even poorer in dry residue than the unconditioned heat saliva, with a marked increase in ash content for both the parotid and the submaxillary gland, and had a very low viscosity.

Montanaro, Juan C., and Julio L. Hanón, 1934. CRISIS SALIVARES TABÉTICAS [Tabetic salivation crises]. *Semana méd.* (Buenos Aires), 41 (47): 1619-1624. In Spanish.

A male patient, 45 years old, with cerebral tabes, experienced a series of gastric crises accompanied by profuse salivation. Analysis of the saliva collected during one of the crises, gave the following results: Density at 17° C, 1.003; slightly alkaline. Constituents per 1000 cc.: water, 994 g.; solids, 6 g.; residuum after calcination, 1.12 g. [?]; chlorides (as NaCl), 1.45 g.; phosphates (as P_2O_5), 0.385 g.; urea, 0.378 g.; mucin, little; albumin, 0.15 g.; proteins, ptyalin, alcoholic extract, 4.88 g. Diastatic power (by Wohlgemuth's method), 20 cc. of 1% solution of starch.

Compared to normal saliva, the saliva of the patient appeared to be diluted. It is concluded that it probably consisted of mixed saliva with predominant parotid component.

Montgomery, Mary F., 1930. EFFECT ON THE TEETH OF TOTAL ABSENCE OF SALIVARY SECRETION. *Jour. Amer. dent. Assoc.*, 17 (7): 1338-1339.

In an attempt to determine the role of saliva in the prevention of dental caries, the submaxillary, sublingual, parotid, and orbital glands of dogs were removed and the animals maintained on a soft, moist diet of cooked meat, bread, and milk. The observational procedures employed did not permit definite conclusions concerning the influence of the absence of the glands on teeth condition, except to indicate that another factor besides saliva should be sought for its role in the prevention of caries.

Montgomery, Mary F., 1931. THE INFLUENCE OF ATROPIN AND PILOCARPIN ON THIRST (VOLUNTARY INGESTION OF WATER). *Amer. Jour. Physiol.*, 98 (1): 35-41.

Neither atropin nor pilocarpin injections significantly altered the water intake of dogs with or without salivary glands. Any changes, therefore, that may occur in water ingestion after injection of these two drugs are to be attributed to factors other than drying or moistening of the oral mucosa by suppression or stimulation of salivary secretion.

Montgomery, Mary F., 1931a. THE RÔLE OF THE SALIVARY GLANDS IN THE THIRST MECHANISM. *Amer. Jour. Physiol.*, 96 (1): 221-227.

A limited review of literature data on the physiology of thirst is presented.

The relationship of the salivary glands to the thirst mechanism and to the condition of the oral mucosa was studied. All eight (parotid, submaxillary, sublingual, and orbital) glands were removed in two groups of 3 dogs each and the effects on the oral mucosa and on water intake were observed at various times over about a one-year period. The method is described in full.

"Total extirpation of the salivary glands in dogs does not increase their average daily water intake. Therefore it appears improbable that the salivary glands play a major role in the thirst mechanism.

"After total extirpation of the salivary glands in dogs the buccal mucosa remains in a healthy and remarkable moist condition." (Author's conclusions.)

Montgomery, Mary F., 1934. STUDIES UPON SECRETORY ACTIVITY OF GLANDS OF THE ORAL AND PHARYNGEAL MUCOUS MEMBRANES. *Proc. Soc. exper. Biol. Med.*, 31 (6): 717-719.

A series of experiments on dogs indicated the following: the glands of the oral and pharyngeal mucosa have a dual innervation, by both the sympathetic and cranial autonomic systems; they do not secrete continuously, but only when adequately stimulated (by pressure, odors, foods, etc); of the stimuli applied, hydrochloric acid was most potent, followed by magnesium sulphate, sodium chloride, and sucrose. Peptone powder produces slight secretion; dry meat---less, and raw meat---only scant secretion. Dry bread crumbs are an effective stimulus.

Montgomery, Mary F., 1935. EFFECT OF AMYTAL UPON PILOCARPINE--INDUCED SUBMAXILLARY AND GASTRIC SECRETION. *Proc. Soc. exper. Biol. Med.*, 32 (8): 1287-1290.

The effects of amytal upon the secretory response of the submaxillary gland to pilocarpine was studied in three dogs having permanent submaxillary fistulae; studies were made on 2 normally innervated glands and on 2 glands after the chorda tympani nerves had been severed at the point of junction with the lingual nerves. Amytal (as sodium salt in doses of 5 to 65 mg./kg.) was administered orally or intravenously after the normal influence of pilocarpine (intravenous injections of 0.2, 0.4, or 0.6 mg./kg.) upon the gland had been determined. Data are tabulated (cf. p. 1288).

In general, amytal shortened the secretory effect of pilocarpine. When administered by

either route, amytal was effective, all doses above 10 mg. producing a delayed shortening of the pilocarpine effect on the second day. When amytal doses of 5 mg./kg. were administered per os, no significant alteration of response to pilocarpine was observed in one dog having a denervated salivary gland. Repetition of this dosage on four successive days produced a marked shortening of the duration of the pilocarpine effect on the 5th day. The foregoing, and the fact that large doses of amytal are associated with long periods of recovery, indicate that sodium amytal (or its decomposition products) may remain in glandular tissues for considerable lengths of time.

Montgomery, Mary F., and J. Star Stuart, 1936. STUDIES UPON THE SECRETION OF ORAL AND PHARYNGEAL MUCUS. *Amer. Jour. Physiol.*, 115 (3): 497-506.

Experiments were made on 12 dogs comparing the secretory response of the oral and pharyngeal mucous membranes with those of the salivary gland. The mucous glands were found to resemble the salivary glands in their response to drugs and reflex stimuli.

Injections of pilocarpine, physostigmine, or acetylcholine induced secretion in the oral and pharyngeal mucous glands of anesthetized dogs. Atropine sulfate counteracted these drugs and stopped mucous secretion reflexly induced in unanesthetized dogs by sucrose, NaCl, HCl, and Mg SO₄, meat, bread, and distilled water. Atropine did not eliminate secretion induced by excitation of the cervical sympathetic trunk nor by injections of epinephrine. Minute quantities of mucus were secreted by 3 of 6 dogs treated with epinephrine. Morphine sulfate caused a temporary increase in mucus production followed eventually by a period of depressed production coincident with diminished response to reflex stimulation.

The mucous glands were found to be more responsive than the salivary glands to mechanical stimulation of the mouth, with generally lower thresholds to weak food and taste stimuli with the exception of acid. They also maintained a normal secretion rate longer during periods of water privation. The salivary glands secreted more than the mucous glands upon stronger food and taste stimuli.

Moor, J. Rothwell, and D. Rourke Gilligan, 1951. PAPER PARTITION CHROMATOGRAPHY OF FREE AMINO ACIDS AND PEPTIDES OF NORMAL HUMAN SALIVA. *Jour. nation. Cancer Inst.*, 12 (3): 691-697.

Paraffin-stimulated saliva samples were collected from 8 normal, fasting (overnight) persons and tested for free amino acids and peptides by two-dimensional paper chromatographic methods (described in full).

In chromatograms of the alcohol filtrates and the dialysates, analine, aspartic acid, glutamic acid, γ -aminobutyric acid, and glycine were present in all samples. Cysteic acid, taurine, the leucines, and valine, serine, and arginine occurred occasionally.

On the chromatograms of the hydrolyzed alcohol filtrates and dialysates, the peptide forms of analine, aspartic acid, glutamic acid, and glycine were consistently present. Detectable amounts of proline always occurred, and an increase in the leucines, lysine, valine, tyrosine, and serine occurred occasionally.

The total concentration of α -NH₂N of the detectable free amino acids was estimated at 0.23 + mg./100 ml. saliva, average. After hydrolysis, the total concentration was estimated at 1.9 mg./100 ml., an increase of approximately 8 times.

In comparison with chromatograms of the free amino acids of plasma and gastric juice, a marked difference was observed. In saliva, glycine, plus γ -aminobutyric acid composes approximately 2/3 of the total detectable free α -NH₂N, whereas in gastric juice, the leucines plus valine and γ -aminobutyric acid compose approximately 2/3 of the total, and in plasma, glutamine plus the leucines predominate.

The total of free detectable α -NH₂N of saliva is only about 25% that of gastric juice and 10% that of plasma. The concentration of peptides appears to be 1/5 that in gastric juice of normal fasting persons, but is relatively higher than in the plasma.

Morishita, Toshiki, 1929. STUDIES ON DENTAL CARIES, WITH SPECIAL REFERENCE TO ACIDURIC ORGANISMS ASSOCIATED WITH THIS PROCESS. *Jour. Bacteriol.*, 18 (3): 181-198.

A study was made of the characteristics and reactions of bacteria secured from the saliva and plaques, and from suspected caries-areas of children aged 8 months to 10 years and showing early, advanced, and absent dental caries. Salivary samples were collected with a swab. Test materials were cultured in 1% glucose hormone, yeast broth, and acidified broth.

Highly aciduric and acid-tolerant organisms were constantly recovered from enamel caries in 93% of the caries-positive individuals; the same type of bacteria were present in the salivary samples of 98% of the caries-cases. Investigations of the plaque samples revealed the constant presence of aciduric organisms; these were rare in the salivary samples secured from infants.

The aciduric organisms isolated from both materials revealed characteristics common to the *Lactobacillus* genus; their morphological and cultural features are discussed.

Morishita, Toshiki, 1929a. FURTHER STUDIES ON CERTAIN ACIDURIC ORGANISMS OF DENTAL AND SALIVARY ORIGIN. *Jour. Bacteriol.*, 17 (1): 7-8.

A morphological and serological study was made of 105 strains of aciduric organisms (seven resembling *Lactobacillus acidophilus*) isolated from dental caries and saliva. No experimental data are presented.

Morris, J. Lucien, and Vernon Jersey, 1923. CHEMICAL CONSTITUENTS OF SALIVA AS INDICES OF GLANDULAR ACTIVITY. *Jour. biol. Chem.*, 56 (1): 31-42. xxxi-xlii

Human resting and paraffin-activated salivary samples were collected for half-hour periods over a certain length of time and were analyzed for salivary urea, ammonia, amino-acids, creatinine, and uric acid utilizing the Folin-Wu methods.

An increase in salivary flow of 429% resulted when secretion was stimulated by chewing paraffin. Increases in the constituents were as follows: amino-acid nitrogen, 722%; urea plus ammonia nitrogen, 374%; creatinine, 118%; and uric acid, 63%.

1 cc. of 2% acetic acid dropped into the mouth every 6 min. produced an increase in volume of 560%; amino-acid nitrogen, 302%; urea plus ammonia

nitrogen, 200%; creatinine, 124%; and uric acid, 71%.

When 1/12 grain of pilocarpine was taken orally, the volume rose to its maximum (84.4 cc.) an hour after the administration of the drug, with an increase of 502%. Urea plus ammonia nitrogen increased 445%; amino-acid nitrogen, 249%; creatinine, 171%; uric acid, 183%.

Ingestion of 1/50 grain of atropine caused a decrease in the volume from 20 to 2.5 cc. (88% fall) and in the uric acid content from 0.5 to 0.17 mg. (66% decrease).

Data collected from two subjects when fasting and when eating purineless and purine-rich diets indicated that extremes in diet produce no definite changes in the volume of salivary flow or in the uric acid content.

It is concluded that the variations observed in saliva secretion as a result of different kinds of stimuli bear definite relations to the nature of the activating forces. Although final interpretations are not yet warranted, the selective effects of the stimuli indicate that several factors are involved in the elaboration of the secretion and that these factors (filtration, metabolism) are stressed in different proportions under various stimuli.

Morris, J. Lucien, and Charles T. Way, 1924. FURTHER OBSERVATIONS ON CHEMICAL CONSTITUENTS OF SALIVA. *Jour. biol. Chem.*, 59 (1): xxvi-xxvii.

A comparative study was made of variations in the amount of urea, uric acid, and glucose present in both the salivary glands and blood, especially during pathological conditions. It was demonstrated that the glucose content of saliva remains rather constant even though there is a variation in blood-glucose. Salivary urea tends to increase with an increase in blood-urea. The excretion of uric acid by the salivary glands represents its cellular metabolic activity.

Morton, Harry E., Paul F. Smith, Ned B. Williams, and Charles F. Eickenberg, 1951. ISOLATION OF PLEUROPNEUMONIA-LIKE ORGANISMS FROM HUMAN SALIVA: A NEWLY DETECTED MEMBER OF THE ORAL FLORA. *Jour. dental Res.*, 30 (3): 415-422.

One hundred and ten saliva samples from 100 individuals were examined for the presence of pleuro-pneumonia like organisms; method is described in full. 51 samples (from 28 of 60 women and 18 of 40 men) were positive.

The authors cite this as being the first report of the presence of pleuro-pneumonia like organisms in high numbers outside the human genitourinary tract.

Morzycki, Georges, 1934. L'HÉRÉDITÉ DES PROPRIÉTÉS DE LA SÉCRÉTION DES FACTEURS CONSTITUANTS DES GROUPES O, A, B DANS LA SALIVE [Inheritance of the property of secretion of the constituent factors of groups O, A, and B in the saliva]. *Compt. rend. Soc. Biol. (Paris)*, 115: 658-660.

Agglutination tests of the saliva of 202 subjects, belonging to 44 families, showed 76% of these individuals to secrete group factors in the saliva. Six to 8% of the individuals, classed as secretors, were found to secrete small amounts of these factors; intensity of secretion was independent of type of factor. Analysis of the distribution of secretors and non-secretors among the 44 families indicated the ability to secrete to be

independent of the blood type and to be dominant over inability to secrete, the inheritance following a simple 2-factor Mendelian ratio.

Mosler, F., 1864. UBER BESCHAFFENHEIT DES PAROTIDENSEKRETES BEI DIABETES MELLITUS UND DURCH HERBEIGEFUHRTE MUNDAFFECTION [On the nature of parotid secretion in diabetes mellitus and on the subsequent oral disorder]. *Arch. Heilk.*, 5: 228-235.

Fluctuations of the sugar content of saliva secreted during the pathogenesis of a case of diabetes mellitus is discussed.

Muckenfuss, A. M., 1918. THE PRESENCE OF FOOD ACCESSORIES IN URINE, BILE AND SALIVA. *Jour. Amer. chem. Soc.*, 40 (10): 1606-1611.

The majority of a group of test pigeons suffering from acute polyneuritis responded favorably to treatment with fuller's earth activated with ox bile, human urine, or human saliva. Four animals not receiving any of the preparations succumbed to the disease. Prophylactic tests using saliva, as a possible disease preventive agent failed.

It is concluded that an anti-neuritic food accessory factor or vitamin is probably present in ox bile.

Mühlenbach, Victor, 1939. UNTERSUCHUNGEN ÜBER DIE ROLLE DER SPEICHELKEIME IM DOLD-WEIG-MANNSCHEM HEMMUNGSPHÄNOMEN [Investigations on the role of the salivary germs in the Dold-Weitmann inhibitory phenomenon]. *Zeitschr. f. Hyg. u. Infektionskrankh.*, 121 (5): 569-580.

The role of direct microbial antagonism in the inhibitory action of saliva for certain organisms was studied; the method is fully described. Essentially, bouillon cultures of salivary organisms were mixed with agar and poured into plates which were then inoculated with diphtheria bacilli and compared with control growths of fresh saliva-agar plates. Saliva samples were obtained from 10 test persons. The inhibitory effect of fresh saliva-agar plates was constantly greater than, or at least equal to, that exerted by agar plates mixed with bouillon cultures of salivary microbes.

Incidental to indications of the existence of salivary inhibines, examples of direct microbial antagonism were observed. Both diphtheria bacilli and staphylococci were inhibited by saliva but they, in turn, were strongly antagonistic to salivary streptococci. When streptococci-bouillon suspensions were introduced to agar plates freshly inoculated with diphtheria bacilli or staphylococci or if, contrarily, the latter organisms were introduced to streptococci agar plates, a marked inhibition of the staphylococci diphtheria bacilli occurred.

The inhibitory powers of streptococci varied among strains, being totally absent on occasion, and fluctuated from time to time in the same strain.

The authors conclude that contamination of pure cultures of streptococci decreases or even removes the inhibitory activities of the streptococcal cultures for diphtheria bacilli and staphylococci.

Muhler, Joseph C., and H. M. Swenson, 1947. PREPARATION OF SYNTHETIC SALIVA FROM DIRECT

ANALYSIS OF HUMAN SALIVA. Jour. Dental Res., 26 (6): 474.

"Eleven patients contributed saliva for an experiment designed to measure quantitatively the important constituents of saliva. With special emphasis placed on control of diet, time and rate (amount) of secretion, factors used for stimulation, etc., a saliva was synthesized which closely approached that of the human sample. It contained in exacting proportions sulfur, 0.0076 gm.; Mg as $Mg_3(PO_4)_2$, 0.0090 gm.; glucoprotids in the form of mucin, 20.0000 gm.; CO, NH_3 , NH_4OH , N_2 and ash in the form of urea, 5.0000 gm.; NaCl, 2.0000 gm.; H_2O q.s. 5 liters. The solution was regulated with a universal buffer to an average pH of 6.9 to 7.1." (Author's abstract)

Muhler, Joseph C., and D. Bixler, 1956. DECREASED ACTIVITY OF DENTAL CARIES IN DESALIVATED ALBINO RATS. Jour. Dental Res., 35 (4): 615-619.

Dental caries experience was studied in 100 female weanling, Sprague-Dawley rats which were divided into 4 groups: those with major salivary glands removed, those with salivary glands and mandibular molars removed, those with mandibular molars only removed, and non-operated controls. Results, after 100 days on a cariogenic corn diet, showed a low caries incidence to occur in the absence of the mandibular molars whether saliva was present or absent. A pronounced increase in caries incidence was noted in desalivate rats with mandibular molars present. Saliva is more important in the extension of dental lesions than in their primary development. Animals lacking salivary glands and maxillary molars showed large amounts of debris, resembling materia alba, on other teeth; this condition, noticeably absent in the other 3 groups, was not accompanied by increased development of caries. In a second experiment caries development was studied in 25 desalivate and in 25 normal, control albino rats pair-fed a high sucrose diet for 100 days instead of the corn diet. Results showed that desalivation does not produce a destructive type of dental caries even in the presence of mandibular molars. These findings suggest that desalivation alone has little influence on the development of dental caries in the albino rat in the absence of initiating factors.

Muhler, J. C., D. Bixler, and W. G. Shafer, 1957. THE EFFECT OF PILOCARPINE ON DENTAL CARIES IN THE RAT. Jour. dent. Res., 36 (6): 883-885.

Approximately 150 weanling Sprague-Dawley strain rats were divided into 5 groups according to initial body weight. Animals in a group were given either 2, 6 or 12 mg. of pilocarpine nitrate by stomach tube, or were fed 10 to 20 mg. of desiccated thyroid daily for 100 days; one group served as controls. Administration of pilocarpine increased salivary flow, most marked in the 6 and 12 mg. groups, beginning 30 minutes after administration and persisting in some animals for 1 to 2 hours. A significant decrease in dental caries was noted in rats receiving 2 mg. of pilocarpine daily; similar effects were produced by the desiccated thyroid.

Muhler, J. C., and D. Bixler, 1958. THE EFFECT OF PILOCARPINE IN SINGLE OR DIVIDED DAILY DOSES ON THE INCIDENCE OF DENTAL CARIES IN THE RAT. Jour. dent. Res., 37 (3): 410-411.

The same amount [2 mg.] of pilocarpine was given to rats either once a day, 3 times a day, or in the diet which was fed ad libitum and the dental caries experience compared to control animals receiving no pilocarpine. The data indicated that all 3 groups receiving the pilocarpine had a significant reduction in dental caries. The anticariogenic effect of pilocarpine does not seem to be related to frequency of ingestion, but instead may be related to differences in the chemical composition of the saliva following pilocarpine administration. (Author's summary)

Mulinos, Michael G., and C. C. Lieb, 1929. Pharmacology of learning. Amer. Jour. Physiol., 90 (2): 456-457.

Observations in the dog and cat of the salivary reflex as well as the use of morphine, pilocarpine, and atropine were employed to study the conditioning-unconditioning-reconditioning processes in relation to the cerebral hemispheres.

Müller, Erik, 1896. DRÜSENSTUDIEN [Glandular studies]. Arch. Anat. und Entwicklungsgeschichte, 1896 (5-6): 305-332.

The phases of the development of secretion of the salivary glands are analyzed in great detail.

Müller, Friedrich, 1901. BEITRÄGE ZUR KENNTNIS DES MUCINS UND EINIGER DAMIT VERWANDTER EIWEISSTOFFE [Contributions to the study of mucin and several related proteins]. Zeitschr. f. Biol., 42: 468-564.

Extensive biochemical studies of the mucin of sputum, submaxillary gland, and ovarian cysts (pseudo-mucin) were made.

Munch, James C., 1934. SALIVA TESTS. I. MORPHINE. Jour. Amer. pharm. Assoc., 23 (8): 766-774.

A standardized technique and bioassay method is presented for the detection of morphine in saliva. The saliva test is based on the characteristic symptoms, mouse-tail reaction, produced in mice by the subcutaneous injection into the abdominal wall of the drug or salivary sample containing morphine. Therapeutic doses as small as 0.2 gm./kg., or doses for "doping" could be detected by this method in equine saliva over a half-hour period without concentrating the sample; concentration of the sample increased the sensitivity of the test. The administration of arecoline increased the salivary response but did not affect the elimination of morphine in the saliva.

Muracciolo, Jaun C. 1955. EVALUATION OF CARIES ACTIVITY BY THE BUFFERS OF SALIVA. Jour. Dental Res., 34 (3): 387-389.

To determine the buffer capacity of saliva, 3 ml. of paraffin-stimulated saliva is diluted to 6 ml. with distilled water and 3 drops of chlorophenol red indicator added. The mixture is titrated with 0.01 N lactic acid. Evaluation of the test in studies on 204 children showed those who were immune to caries to have a high buffer power, averaging 7.5 ml. lactic acid to lower the salivary sample from pH 7 to 6. Active caries children had low buffer power, averaging 3.7 ml. lactic acid to produce the pH change.

Mushegian, G. N., and A. S. Saakian, 1949. KOLEBANIYA KOLICHESTVA ROSTOVYKH VESHESTV V

MOCHE I SLIÛNE U RAKOVYKH BOL'NYKH [Variations in the amount of growth elements in the urine and saliva of cancer patients]. Nauchnye Trudy Inst. Fiziol. Akad. Nauk Armiansk. SSR, Erevan, 2: 57-61. Abst.: Sovet. med. refer. Obozrenie, Onkol., 1951 (4): 11.

A series of growth elements of the heteroauxin type, found in the tissue of malignant tumors, have also been found in the urine and saliva of healthy men. The concentration of these elements was studied in the saliva and urine of cancer patients having variously localized tumors, before and after an operation or X-ray therapy of the tumor. The activity of these growth elements was tested by measuring coleoptile curvature at 12-hour intervals after attachment of a gelatine block, containing the saliva or urine, to the side of the decapitated and isolated coleoptile. Results showed an initial increase in the number of growth elements after the tumor operation or X-ray therapy, followed by a sharp decrease with the patient's improvement. Control tests with the saliva or urine of healthy people showed a very low percentage of growth elements as compared to cancer patients. The authors believe that the growth elements are formed in the malignant tumor, then enter the blood stream and are secreted by the kidneys and the salivary glands.

Myers, Rollin C., and Leonard C. Scott, 1918. SALIVARY AMYLASE. I. A PRELIMINARY EXPERIMENTAL STUDY OF ITS STABILITY IN SALIVA. Jour. Amer. chem. Soc., 40 (11): 1713-1716.

Salivary amylase, in sterile saliva, was demonstrated to retain a relative (50% plus) amount of its enzymatic ability over a period of one year under conditions of diffuse light and temperatures of 18 - 28° [C?]. Under similar conditions, toluene, thymol, and chloroform, in that order, were found to preserve some (50% or less) of the amylolytic activity of unsterilized salivary amylase. Saliva (unsterilized, with no preservative) in a stoppered container revealed some reducing power after 2.5 years.

Myers, Victor, and W. Lloyd Adams, 1932. AMYLOLYTIC ACTIVITY OF SALIVA. Jour. dental Res., 12 (3): 436-437.

The amylolytic indices of the salivas of 26 medical students (21 free from colds and 5 with severe colds) were determined by the method of Myers (1918m) and the influence of salt content upon the amylolytic activity was studied.

The data for the subjects free of colds were arranged in order of decreasing amylolytic activity. The average values for the 4 individuals on top of the list were: 14 mg. total phosphorus, and 65 mg. NaCl per 100 cc. saliva; those for the 4 individuals at the foot of the list were 20 mg., and 116 mg., respectively. When NaCl was used as diluent, the amylolytic index for the 4 individuals at the top of the list showed an average increase of 19 (from 31 to 50), while that for the individuals at the foot showed an average increase of 7. It seems therefore that the Cl content and, to a lesser degree, the phosphate content, have an important influence on the amylolytic index.

No influence, however, was noted in the saliva samples of the five subjects having severe colds; the amylolytic indices were invariably low (18-24) during the severe stages of the colds.

Myers, Victor C., and Anne G. Dellenbaugh, 1918. STUDIES ON THE AMYLOLYTIC ACTIVITY OF HUMAN SALIVA WITH A NEW METHOD. Proc. Soc. exper. Biol. Med., 16 (2): 18-20.

The authors describe a method for estimating the amylolytic activity of human saliva.

A specimen of paraffin-activated saliva is filtered, a small portion diluted 1:100 with distilled water, and another portion with 0.3% NaCl as an activating solution. 1 cc. of diluted saliva is pipetted into a test-tube and the tube placed in a water bath (40°). After 5 min. 1 cc. of 1% soluble starch solution is added and the mixture allowed to incubate for 30 min. At the end of this time 3 cc. of saturated picric solution and 1 cc. of 20% sodium carbonate are added; the tube is then placed in boiling water for 15-20 min. After it has cooled, it is diluted with distilled water in a graduated cylinder until the intensity of the color approximates that of the standard (glucose in picric acid treated with sodium carbonate and heated); the test sample is then compared with the standard in the colorimeter. The amylolytic activity is recorded in terms of the percentage of starch converted into sugar.

The method was applied to a number of normal individuals; the amylolytic activity of the majority of salivas ranged between 30 and 45% when water was used as the diluent. When NaCl solution was employed, the variations were small, falling between 46 and 50%; thus the possibility was suggested that in some individuals a considerable part of the enzyme is secreted in the zymogen form.

Data regarding the application of this method to diseased persons are given.

Myrback, K., 1926. ÜBER VERBINDUNGEN EINIGER ENZYME MIT INAKTIVIERENDEN STOFFEN. II. [Combination of enzymes with inactivating substances. II.]. Hoppe-Seyler's Zeitschr. physiol. Chem., 159 (1-4): 1-84.

The combination of salivary amylase with neutral salts was analyzed, and the results tabulated. The following aspects are discussed: activation by sodium chloride and the pH curve of Cl-amylase; the curve of acidity of salt-free amylase; chloride and chlorate amylase; other salt-amylases; the enzyme-substrate affinity; kinetics of decomposition; the theory of sodium action; and the nature of sodium amylase.

The highlights of another chapter discussing the combination of the salivary amylase with inactivating substances were: the salivary amylase as a base; the effect of HNO₂ on the salivary amylase; the chloride amylase acting as acid (an analysis of the inactivation of metals such as copper, mercury, and silver); and nitrate amylase acting as acid.

The inactivation of invertin by metals may be explained as a salt-formation process of the enzyme-acid; in activation of invertin by reagents such as phosphotungstic acid, picric acid, etc., however, was considered a salt-formation process of the enzyme-base. The inactivation of invertin by halogens, especially by iodine, showed the same affinity to the substrate, and the same curve of acidity as the free enzyme.

A series of tests show salivary amylase to be identical with pancreatic amylase.

Naumenko, A. I., A. I. Rappaport and B. I. Stozharov, 1938. SOOTNOSHENIE MEZHDU RITMOM RAZDRAZHENIYA I VELICHINOI SEKRETSII OKOLOUSHNOI SLIUNNOI ZHELEZY [The relationship between the rhythm of the stimulation and the quantity of parotid secretion]. *Fiziol. Zhur. SSSR*, 24 (5): 888-894.

The relationship between the amount of parotid secretion and the stimulation rhythm was studied in dogs under severe experimenting conditions. After injection of morphine and ether-chloroform anesthesia, the auriculotemporal nerve was prepared by the Navrocky method (1876), ligated and resected. A cannula was placed into Stenson's duct. The stimulation was done through induction current (Aimmermann's coil of 10,000 double coils). Twelve experiments were made with approximately similar results.

A regular relationship was obtained between the quantity of parotid secretion and the frequency of stimulation rhythm. Similar to that obtained for the submaxillary gland (Kupalov and Skipin, 1934). The curve obtained is a perfectly regular hyperbola. The parotid gland was found to have a much lower summation capacity than the submaxillary gland. The gland's maximum capacity limit of summing individual stimuli was observed to be 4 stimuli per second. The optimum frequency of rhythm through electric stimulation of the auriculotemporal nerve was 32 to 50 beats per second; with impulses of 50 to 64 beats/sec. secretion decreased to a [minimum] (pessimum of frequency). After a 1 to 2 sec. stimulation of the auriculotemporal nerve with induction beats, the parotid secretion lasts 20 to 30 sec. The duration of the secretory after-effect is 3 to 8 times smaller in the parotid than in the submaxillary gland. Consequently, the parotid is much more appropriate to reflect the processes which take place in the central nervous system and offers considerable advantages for the study of conditioned reflexes.

After stimulation of the nerve with induction current for 1 sec. with intervals of 5 to 10 sec., a secretion is obtained which increases regularly and evenly with every stimulation.

Naumenko, A. I., and A. I. Rappaport, 1940. OSOBNOSTI BEZUSLOVNOI I USLOVNOI SEKRETSII OKOLOUSHNOI I PODCHELIUSTNOI SLIUNNYKH ZHELEZ [Peculiarities of the unconditioned and conditioned secretions of the parotid and submaxillary glands]. *Fiziol. Zhur. SSSR*, 29 (6): 501-503.

The flow of parotid and submaxillary secretion was studied in 6 dogs (covering 30 experiments) whose glands had permanent fistulae. The dogs were either fed or teased with food during 1 min. at 10 to 15 min. intervals. At the point of decrease of salivation each drop per second was measured. The curves obtained showed that the extinction of natural conditioned secretion from the parotid and the submaxillary glands are absolutely analogous with the curves of the same glands resulting from stimulation of the secretory nerves through an induction current. The extinction of submaxillary secretion proceeds slower, lasting up to 5 or 6 min., and is characterized by a regular decrease in the rapidity of secretion. Parotid secretion starts abruptly and ends in 12 to 30 sec. (not over 1 min.). The parotid gland is a more labile organ than the submaxillary, reflecting more accurately the activity of the nervous centers in relation to time.

Naeslund, Carl, 1926. A COMPARATIVE STUDY OF THE FORMATION OF CONCRETIONS IN THE ORAL CAVITY AND IN THE SALIVARY GLANDS AND DUCTS. *Dental Cosmos*, 68 (12): 1137-1144.

Histological investigation of supragingival and subgingival calculi, as well as calculi occurring in the salivary gland system, has revealed in addition to regular oral bacteria an organic stroma of thread-like organisms composed principally of *Actinomyces* and *Leptothrix*. The regular and characteristic manner in which both organisms occur in tartar as well as in salivary duct calculi is taken as evidence that the organisms originally grew in the site of concretion formation, which developed through precipitation and deposition of lime in their meshwork. Experiments were conducted using pure cultures of either *Actinomyces* or *Leptothrix*, obtained from tartar and salivary duct calculi, and lime-containing sterile saliva; after 1- to 2- months of incubation concretions were observed which appeared histologically and chemically similar to naturally formed concretions. A similar experiment using heat-killed organisms produced no concretions. In another series of experiments fresh saliva, with or without addition of 1 to 2% thymol or phenol to inhibit bacterial action, was incubated at 37°C with either straw or other plant parts, or extracted teeth. The saliva was renewed twice daily, while the objects placed in it were washed with physiological salt solution. After 2 month of such treatment unmistakable lime incrustation was observed on the objects placed in the non-inhibited saliva. It is concluded that precipitation of lime from saliva takes place as the result of biochemical processes, principally a decrease in H-ion concentration, with a physical-chemical contributory action producing a condensation of colloids in saliva or exudate.

Naeslund, Carl, 1929. FORTGESETZTE UNTERSUCHUNGEN UBER DIE SPEICHELSTEINBILDUNG UNTER BESONDERER BERÜCKSICHTIGUNG IHRES VERHÄLTNISSSES ZUR ENTSTEHUNG PRIMÄRER SPEICHELDRÜSENAKTINOMYKOSE [Further investigations on the formation of salivary calculi, with particular regard to its relation to the development of primary salivary gland actinomycosis]. *Acta pathol. et microbiol. scandinav.*, 6: 78-96.

In 50 cases of sialolithiasis, actinomycetes could be cultured from the salivary concretions. Both saprophytic actinomycetes and pathogenic forms of the Wolff-Israel type appeared in the cultures. Inoculations of the cultures in experimental animals produced progressive actinomycosis. Actinomycetes have also been cultured from healthy mouths.

Necheles, H., and P. Levitsky, 1937. STUDIES ON CONSTITUTION AND PEPTIC ULCER. IV. SALIVARY SECRETION TEST IN PEPTIC ULCER PATIENTS AND NORMAL SUBJECTS. *Jour. Lab. clin. Med.*, 22 (6): 624-626.

A study was made of the rate of salivary secretion of 34 male peptic ulcer patients and 30 normal male individuals who were free of any gastrointestinal complaints. Results indicated that the salivary response to pilocarpine stimulation was significantly less in the peptic ulcer patient. It is suggested that this finding supports the concept of an autonomic imbalance in peptic ulcer patients.

Necheles, H., and Wm. H. Olson, 1942. EXPERIMENTAL INVESTIGATION ON THE EFFECTS OF TRAUMA AND TRAUMATIC SHOCK ON GASTRO-INTESTINAL MOTILITY AND SECRETIONS. *Amer. Jour. Physiol.*, 136 (1): 33-37.

A study of submaxillary secretion was included in an investigation on the results of mechanical trauma on gastro-intestinal functions of the dog. Normal healthy dogs were fasted for 30 hours but had access to water. Sodium pentobarbital or ether were used as an anesthetic, and trauma was administered to back legs.

In three control experiments (12, 12 and 6 hours) without trauma an intravenous infusion of glucose was administered continuously. Pilocarpine and secretin were administered alternately each hour and changes in stimulated secretion were noted. The salivary secretion did not change.

In two cases with trauma but without pilocarpine or secretin saliva secretion dropped from 1 drop per 15 minutes to 0 (blood pressure drop 140 to 90 mm. Hg) and from 20 drops to 0 (blood pressure from 120 to 40). At the end of the first experiment, injection of 0.5 mg. of pilocarpine produced a flow of 54 drops per 15 minute period. In two experiments, similar to the control but with trauma, the salivary secretion was affected slightly or not at all.

The authors point out that the depression effect of mechanical trauma on salivary secretions is considerably less than that of thermal trauma.

Neild, Newman, and E. V. Dunkley, 1909. THE ROLE OF THE SALIVA IN THE TRANSMISSION OF TUBERCLE. *Lancet* (London), 176 (4468): 1096-1098.

A review of cases is presented in which the tubercle bacillus [*Mycobacterium tuberculosis*] was shown to be present on the tongue and in the saliva. It is suggested that the transmission of tuberculosis may be accomplished through objects contaminated with saliva and not through sputum alone.

Neilson, C. Hugh, and Oliver P. Terry, 1906. THE ADAPTATION OF THE SALIVARY SECRETION TO DIET. *Amer. Jour. Physiol.*, 15 (4): 406-411.

The effects of certain diets of bread and meat on the amylolytic power of the submaxillary saliva were studied in dogs. Amylolytic power was determined by reduction tests using Haine's solution. If cuprous oxide was precipitated immediately or after standing a few hours, the test was considered positive and the time noted. Sugar appeared in the bread-fed dogs much sooner (in 30 min.) than in the meat-fed dogs (in 60 min.).

Neilson, C. Hugh, and D. H. Lewis, 1908. THE EFFECT OF DIET ON THE AMYLOLYTIC POWER OF SALIVA. *Jour. biol. Chem.*, 4 (6): 501-506.

Tests of human saliva, sampled on successive days, revealed that the salivary secretions from those persons consuming a diet rich in proteins contained a lesser amount of amylase than normal. However, those persons subsisting, for a period of time, on a carbohydrate diet produced a saliva of higher amylase content than normal. It is postulated that the consistency of the food, the rate of salivary flow, or the type of salivary stimulus may be related to the above effects.

Nekachalova, I. IA., 1947. IZMENENIE V DEIATEL' NOSTI NEKOTORYKH PISHCHEVARITEL'NYKH ORGANOV PRI KORKOVYKH TORMOZNYKH SOSTOIANIIAKH [Changes in

the function of some digestive organs under conditions of cortical inhibition]. *Biull. eksper. Biol. Med.*, Moskva, 23 (4): 310-312.

Two hundred tests were made in 14 dogs, having salivary and gastric fistulas, of salivary changes following prolonged salivary stimulation; 0.8 to 1.0 gm. portions of rusk were fed for 2 to 3 hour periods at intervals of 10 to 15 seconds or of one minute. Determinations were made of the salivary dry residue and of the organic content. Severe glandular exhaustion was verified in preliminary tests showing depletion of salivary organic content after prolonged food stimulation, or unchanged pilocarpine salivation under the same conditions. Oral feeding of milk tubally for 3 hours, to eliminate conditioned receptors as eye, nose or ear, showed an absence of glandular exhaustion although the amount of salivation was very high; a persistent but not very pronounced decrease in the salivary dry residue occurred when the milk was fed by saucer. The influence of gastric receptors on glandular exhaustion was studied by continuously irrigating the gastric mucosa with physiological salt solution at 38°C. Glandular exhaustion was retarded and fairly stable when food did not accumulate in the stomach; restoration to normal function, usually effected 5 to 6 days after the prolonged feeding, occurred after 15 to 18 days. Consecutive feedings with different foods (milk, sugar, meat, rusk, etc.), fed for 30-minute periods each during 3 to 3.5 hours, produced no signs of exhaustion in salivary samples collected after change of stimulant. A decrease in salivation to 20-30 cc. and a pronounced glandular exhaustion, indicated by a sharp drop in salivary dry residue of the final samples, occurred when the dog was fed 0.8-1.0 gm. rusk in 3-5 seconds and then stimulated visually with rusk for the remainder of the minute during the 3.0-3.5 hour feeding period; the severe exhaustion is attributed to a deeper temporary, inhibition in the cerebral cortex produced by the visual or natural conditioned stimulant. When prolonged visual stimulation was applied during several subsequent days a deeper inhibition and persistent state of glandular exhaustion was produced wherein the salivary composition did not return to normal one year after experimentation. Disinhibition was effected by oral administration of 0.5% hydrochloric acid in cases of temporary inhibition; disinhibition of the persistent state of inhibition was effected by 2 to 3 such treatments administered over several days.

Nekrasov, P. A., and N. V. Khranilova, 1934. VLIYANIE FIZICHESKOI RABOTY NA BEZUSLOVNYI SLIUNNYI REFLEKS U CHELOVEKA [The influence of physical work on the unconditioned salivary reflex in man]. *Arkh. Biol. Nauk*, 34 (5-6): 593-603.

Experiments were made in the parotid gland of one 19 year-old man over a period of 6 months in a preliminary study of the influence of fatigue on unconditioned salivary secretion. The saliva was collected by the Krasnogorskii-Iushchenko method in 5 min.-samples and the secretion registered by a modified Iushchenko electrical drop-register during the 5 min. of salivation. Stimulation was produced by a 15 gm. cookie eaten in 2.5 min. Other stimuli were tried (citric acid, cranberry extract), but proved unsatisfactory. The pH was determined by Michaelis' colorimetric method. Fatigue was produced by two types of work: the lifting of a bar of 15 kg. to a 1 m.

height, 8 times/min. during 20 min., repeated 5 times a day with 40 min. intervals, the delivery of mail twice a day, covering altogether 20 km. with a total of 66 stories climbing and descending.

Tabulated data obtained at rest show that the amount of salivary secretion is influenced by the meal period and is greatest before lunch. The pH varies little, as a rule, within the same day, and remains fairly constant over a prolonged period of time (1 month, in the present experiment).

Production of work, which results in fatigue, noticeably depresses salivation. The depression increases with increased fatigue, and secretion may drop to zero; a repeated stimulation is then necessary to elicit salivation. Thirst, a natural depressor of salivation, could not be made responsible for this result, as the subject was allowed to drink on intervals.

The salivary reaction showed a definite, though small decrease in pH (Starr, 1922), which, in this particular case, could be explained by the increase of CO_2 in the blood. (The relationship between the salivary pH and the CO_2 content of the blood has been pointed out on different occasions (Starr, 1922, and others).

In a series of 9 experiments, 0.01 gm./of caffeine was given to the subject in a cup of tea, without his knowledge. In the walking experiment, a slight reduction of the depression in salivation was noticed, especially after the first route; in the lifting experiment, however, no influence of the caffeine could be detected.

Nemes, J. L., M. G. Wheatcroft, and R. S. Leopold, 1952. EFFECTS OF TOTAL BODY X-RADIATION ON SALIVARY COMPONENTS OF DOGS. *Jour. dental Res.*, 31 (5): 603-608.

Fourteen dogs were exposed to total body irradiation (200, 400, and 600 r.) and a study of the effects on pilocarpine-stimulated saliva led to the following conclusions:

"1. Significant decreases in mean phosphorus and nitrogen content of dogs' saliva occurred following exposure to varying amounts of x-ray irradiation.

"2. Lysozyme activity and acidity of salivas from x-ray irradiated dogs increased (during the 24 day sampling period) following irradiation.

"3. Salivary lysozyme activity was not influenced by a decrease in blood or salivary leukocytes.

"4. Quantitative variations and the chemical constituents of saliva ascertained prior to and after radiation, respectively, do not indicate the possibility of using these changes as a diagnostic means for the evaluation of the effect of total body radiation.

"5. Phase microscopic observations revealed a tremendous increase in bacterial numbers with the onset of oral degenerative changes. The increase in treponemal forms, because of their size and shape, appeared most noticeable during this phase." (Authors' conclusions.)

Nemes, John L., and Merrill G. Wheatcroft, 1952a. ACTION OF SALIVARY LYSOZYME ON MICROCOCCUS *LYSODEIKTICUS*. *Oral Surg.*, 5 (6): 653-658.

A comparison of the modes of attack of crystalline and of salivary lysozyme indicated the two to be similar; observations were made by electron and phase microscopy.

Manifestations of lysis in susceptible cells of *Micrococcus lysodeikticus*, ATCC strain No. 4698, by salivary and crystalline lysozyme were "a gradual digestion of the bacterial cytoplasm and solution of the cell contents without any evidence of rupture of cell wall and egress of cell contents through the fracture." Upon completion of lysis, intracellular inclusions resistant to lysozyme action were evident within the cell.

The time required for digestion of the bacterial cells varied, depending upon the lysozyme titer of the individuals.

Nemtsova, O. L., 1941. ROL' RETSEPTORNOGO APPARATA POLOSTI RTA V SISTEME OBRAZOVANIĖ BEZUSLOVNYKH REFLEKSOV, IZUCHAEMYKH NA SEKRETSII SLIŪNNYKH I ZHELUDOCHNYKH ZHELEZ [The role of the receptor apparatus of the oral cavity in the formation system of the unconditioned reflexes of salivary and gastric secretion]. *Fiziol. Zhur. SSSR*, 30 (4): 440-448.

The relationship between salivary and gastric secretions and the effects on these of conditioned and unconditioned stimuli were studied in 2 esophagotomized dogs having salivary and gastric fistulas. The canine buccal mucosa was irrigated with 250 cc. solutions of food (milk, broth, sugar or saccharin) or of drugs (0.25% HCl or NaOH, 0.3% quinine, 10-20% NaCl, 2.5% acetic acid) by means of an irrigation cap attached to the mucosa. The substances were administered during periods of gastric inactivity and of alkaline mucus reaction; secretion was registered as units of 4 drops. Salivation was usually greatest in response to milk (100-140 units) and lower to broth (75-120 units) or sugar (25-75 units); gastric secretion paralleled salivary except that sugar evoked no gastric secretion. Sodium hydroxide and quinine elicited abundant salivation but no gastric flow, while HCl and NaCl stimulated both secretions. The differences in secretion suggest that taste stimuli determine the direction of nervous impulses. The method of administering the solutions affected the secretion rate, the same amount of solution given in several portions eliciting a considerably greater total secretion than if administered as a unit. Acetic acid if administered as a unit evoked 350 units of saliva; if administered as three separate 80 cc/minute portions, it elicited 775 units during irrigation and 1395 units total salivation; post-irrigation salivation persisted from 3 to 3.5 minutes in both cases. The secretory reflex was much stronger during normal drinking from a bowl during 2.5 minutes than during irrigation; the difference was especially marked in a "greedy" dog who also showed gastric response to sugar. The results show the influence of the conditioned component which normally accompanies the unconditioned reflex.

Nemtsova, O. L., 1948. VLIĖNIĖ RAZDRAZHENIĖ POLOSTI RTA ESOFAGOTOMIROVANNOI SOBAKI PISHCHEVYMI I OTVERGAEMYMI VESHCHESTVAMI NA ZHELUDOCHNIŪ I SLIŪNNIŪ [The influence of oral-cavity stimulation by foods and repellents on the gastric and salivary secretions]. In: *Materialy po Fiziol. Retseptorov* [Data on the physiology of receptors], Moscow, 1948, pp. 131-135. *Sovet. med. refer. Obozrenie*, 1950 (6): 89.

Irrigation of the oral mucosa while glandular activity was at a high level, in an esophagotomized dog fed 100 gm. of meat one hour before the oral stimulation, produced no distinctive change in salivary secretion. Irrigation of the oral mucosa with a 0.25% HCl solution under similar experimental conditions produced only a slight increase in salivary flow by the dog; increase in gastric secretion was pronounced.

Netter, 1887. DU MICROBE DE FRIEDLAENDER DANS LA SALIVE ET DES RÉSERVES QU'IL CONVIENT DE FAIRE AU SUJET DE SON INFLUENCE PATHOGÈNE CHEZ L'HOMME, AU MOINS DANS LES CAS DE PNEUMONIE [On Friedlander's bacillus in saliva and on some reservations that should be made regarding its pathogenic influence in man, at least in the case of pneumonia]. Compt. rend. de la Soc. de Biol. (Paris), 39 (42): 799-806.

Friedländer's bacillus [*Klebsiella pneumoniae*] was isolated from the saliva of 3 healthy adults. The pneumococcus of Fraenkel [*Diplococcus pneumoniae*] was found more commonly in the mouths of healthy people than was *K. pneumoniae*.

Netter, 1888. DU STREPTOCOCCUS PYOGENES DANS LA SALIVE DE SUJETS SAINS [On Streptococcus pyogenes in the saliva of healthy subjects]. Compt. rend. de la Soc. de Biol. (Paris), 40 (27): 644-650.

Of 127 healthy subjects examined *Streptococcus pyogenes* was isolated from the mouths of 7, Friedlander's bacillus [*Klebsiella pneumoniae*] from 5 subjects, and the pneumococcus of Frankel [*Diplococcus pneumoniae*] from 15 to 20% of the individuals. Successive examinations in the same subject sometimes revealed the presence, sometimes the absence of a microorganism; in the course of a 2-year study, 60 examinations of one subject showed the presence of *S. pyogenes* only 5 times. The healthy bucco-pharyngeal mucosa acts as a barrier to bacteria, but with lowered resistance streptococci may be a source of infection.

Netter, A., E. Cesari, and H. Durand, 1921. DÉMONSTRATION DE L'ACTIVITÉ DU VIRUS DE L'ENCÉPHALITE DANS LES CENTRES NERVEUX 15 MOIS APRÈS LE DÉBUT. PRÉSENCE DE CE VIRUS DANS LES GLANDES SALIVAIRES [Demonstration of the activity of encephalitis virus in the nerve centers 15 months after first appearance. Presence of this virus in the salivary glands]. Compt. rend. de la Soc. de Biol. (Paris), 84 (17): 854-855.

Transmission of encephalitis in rabbits was accomplished by injecting a filtrate from salivary gland tissue of an infected rabbit into the cranial cavity of other rabbits. Transmission of the disease was shown, in a test using 7 rabbits, to be more regular and death to occur more rapidly when the filtrate from salivary gland tissue rather than cerebral tissue was used.

Neuwirth, Isaac, and Julius A. Klosterman, 1940. DEMONSTRATION OF RAPID PRODUCTION OF LACTIC ACID IN ORAL CAVITY. Proc. Soc. exper. Biol. Med., 45 (1): 464-467.

Experiments on the action of saliva indicated that the rapid production of lactic acid in the mouth (within 10 minutes) is a result of the action of oral microbes on certain food-stuffs (i.e., glucose, sucrose, starch, gelatin, banana,

etc.). No lactic acid was formed by the action of microbe-free (Seitz filtered) saliva on carbohydrates.

Neuwirth, Isaac, and J. A. Klosterman, 1940a. DEMONSTRATION OF THE RAPID PRODUCTION OF LACTIC ACID IN THE ORAL CAVITY. Jour. dent. Res., 19 (2): 194.

Using the lactic acid method of Miller and Muntz (Jour. Biol. Chem., 126: 413, 1938), we are able to show that within 10 minutes after tablets of dextrose, sucrose, or starch have been completely dissolved in the mouth, there is a marked increase of lactic acid in the contents of oral cavity. This same finding can be demonstrated in vitro by mixing saliva with any one of these carbohydrates, but not with saliva that has been passed through a Seitz filter, such passage resulting in a sterile filtrate. Negative findings in vitro are obtained with inulin, xylose, and arabinose. In the oral cavity, negative results are obtained with gelatin. (Editor's abstract)

Neuwirth, Isaac, and William H. Summerson, 1942. UTILIZATION OF LACTIC AND PYRUVIC ACIDS BY ORAL MICROORGANISMS. Jour. dental Res., 21 (3): 321.

"In work previously reported, ...it was shown by chemical and manometric methods of analysis that oral microorganisms acting on glucose in saliva as a medium produce significantly more acid than can be accounted for by the amounts of lactic acid and pyruvic acid found. A partial explanation for this is indicated by the work now reported, which shows that oral microorganisms can metabolize both lactic and pyruvic acids almost as rapidly as they are formed. The metabolism of lactic acid leads to an intermediate production of significant amounts of pyruvic acid, but the further metabolism of pyruvic acid produces no lactic acid. Thus the appearance of lactic and pyruvic acids in the metabolism of glucose by oral microorganisms represents an intermediate and not a final stage in acid production. The nature of the acid or acids ultimately obtained is under investigation. These experiments were carried out with saliva obtained from carious and non-carious subjects. As in our previous work, no significant differences were evident between these 2 groups with regard to either acid production from glucose or the utilization of lactic and pyruvic acids." (Complete paper.)

Neuwirth, Isaac, 1950. THE PRODUCTION OF ACIDS FROM GLUCOSE BY ORAL MICROORGANISMS: CITRIC ACID. Jour. dental Res., 29 (5): 589-592.

Paraffin-stimulated salivas, mixed with glucose, were incubated at 37°C. and examined after periods of 10 to 60 minutes for possible citric acid production. Not only was no citric acid formed by the salivary organisms [not identified], but a definite loss in the original amount occurred. When more citrate was added, it was rapidly utilized by the oral microbes.

Neuwirth, Isaac, and William H. Summerson, 1951. THE PRODUCTION OF ACIDS FROM GLUCOSE BY ORAL MICROORGANISMS: LACTIC AND PYRUVIC ACIDS. Jour. dental Res., 30 (1): 100-111.

Paraffin-stimulated saliva samples (approximately 10 ml. each) were collected 2 to 3 hours

after eating and were incubated with added glucose. Using the Summerson differential manometer and vessels, measurements of oxygen consumption, respiratory CO₂ production, and total acid production were made. The salivary pH, before and after incubation with glucose, was also determined. After completion of the manometric measurements, deproteinization was carried out according to the Somogyi procedure, and tests for glucose, lactic, and pyruvic acids (when necessary) were carried out by the methods of Benedict, of Barker-Summerson, and of Penrose and Quaslet, respectively.

Regardless of the presence or absence of dental caries, organisms metabolized from approximately 10 to 80% of the glucose present during a 30-minute incubation; the average for 22 experiments was about 34% of the added glucose at an initial glucose level of 0.13%. Results indicated a rough parallel between the rate of oxygen consumption and that of glucose metabolism.

In 22 experiments, 10.2 to 37.9% (average 23.5%) of the metabolized glucose gave rise to lactic acid.

It was indicated that over one-half the acid produced by organisms when incubated in saliva-glucose mixtures may not be lactic acid. Data indicated that from 18.3% to 57.7% (average 41.6% for 20 experiments) is accountable for as lactic acid. Preliminary tests indicated production of pyruvic acid to occur after 30 minutes incubation; little or none was found before that time.

In the second experiment, the test individuals were separated into 2 groups, a caries-positive one and a caries-negative. There was no significant difference between the two groups in either bicarbonate content or pH, nor in the lactate and pyruvate content of various salivary samples. In the *Lactobacillus* counts, however, there was wide variation between the two groups; the caries (past or present) group all harbored oral lactobacilli, while all of the non-carious group failed to exhibit lactobacilli. In the total bacterial count, the carious individuals in general had a higher total bacterial count than did the non-carious.

Neuwirth, I., and P. J. Baerger, 1957. THE PRODUCTION OF ACIDS FROM GLUCOSE BY ORAL MICRO-ORGANISMS: ACIDS OF THE KREBS CYCLE. Jour. dent. Res., 36 (5): 769-770.

Samples of paraffin-stimulated saliva were collected from 42 adult subjects including about equal numbers of caries-active and caries-inactive individuals. Paper chromatographic determinations were made of acids of the tricarboxylic acid cycle present in unfiltered samples of saliva after mixture with glucose and incubation at 37°C. Acids found present after 30 minutes of incubation include succinic, malic, fumaric, lactic, pyruvic, alpha-ketoglutaric, and oxalacetic but not citric. Findings in 6 samples incubated an additional 30-minutes showed the concentration of lactic acid to peak during the first 30 minute period and then decrease sharply; the concentration of oxalacetic remained constant over the one hour period, while the remaining acids increased in concentration with incubation time. No relationship was found between the acid production and the dental caries condition of the saliva donors. Coenzyme A was also found present in detectable amounts in all salivary samples.

Nevin, Thomas A., and Basil G. Bibby, 1951. THE EFFECT OF WATER SOLUBLE CHLOROPHYLL ON PURE CULTURES OF ORGANISMS COMMONLY FOUND IN THE ORAL CAVITY. Jour. dental Res., 30 (4): 469.

Using standard testing methods (not described), 15 strains of microorganisms (5 members each of *Lactobacillus*, *Micrococcus*, and *Streptococcus*), as well as organisms of pooled salivas, were studied to determine their reactions to various concentrations of water soluble chlorophyll. In three series of experiments, a study was made of the possible inhibitory effect of chlorophyll on microorganisms, of any interference with the glycolytic scheme, and of any interference with the respiratory habits of those organisms with which measurements of this type could be made. Results showed that all the organisms studied were inhibited by water soluble chlorophyll; the respiratory inhibition was roughly proportional to the chlorophyll concentration; and the glycolytic action of the individual cell could be stimulated.

Nevin, T. A., M. D. Appleman, and H. M. Kurtz, 1958. THE AVAILABILITY OF CERTAIN STREPTOCOCCAL GROWTH FACTORS IN HUMAN SALIVA. Jour. dent. Res., 37 (3): 527-531.

Tests were made for the presence of pantothenate, niacin, riboflavin, and biotin in aqueous extracts of pooled (100 samples) unstimulated human saliva, collected from subjects fasting for 2 or more hours. Standard microbiological assay methods, adapted for utilization by test organisms, *Streptococcus salivarius* and *Str. faecalis*, showed significant amounts of the four vitamins in the saliva. Comparison of aqueous-, acid-, and heat-extraction methods on 20 pooled samples showed the increasingly rigorous extraction methods to generally demonstrate increasingly greater amounts of the four substances. Aqueous extracts of salivary specimens, collected from 12 individuals prior to and 15 minutes after eating a standard meal, resulted in an increase in biotin level but not in pantothenate or riboflavin levels.

Newman, Henry, and Mason Abramson, 1941. REGULATION OF ALCOHOL CONCENTRATION TO INTOXICATION. Proc. Soc. exper. Biol. Med., 48 (2): 509-513.

The validity of alcohol concentration in man as a reliable index of drunkenness was investigated. Two men were each given 95% grain alcohol (diluted to about 20% with tap water) over a 5-minute or shorter period, on an empty stomach [total amount not specified]. Small doses were diluted with milk to slow absorption, thereby maintaining the blood concentration constant. Blood, urine, and saliva samples were collected at various intervals over 4-7 hours and alcohol determinations were made (Newman's method). Four graphs of results indicate that when alcohol is present in the body for a period of several hours, the nervous system is so affected that concentrations of alcohol which would originally have caused intoxication, now fail to do so. It can be concluded that "the effect of a given concentration of alcohol depends not only on its absolute value but also on how long a time it has been present in the body."

Nickerson, J. F., F. W. Kraus, and W. I. Perry, 1957. PEROXIDASE AND CATALASE IN SALIVA. Proc. Soc. exper. Biol. Med., 95 (2): 405-408.

Determinations were made of peroxidase and catalase activity in samples of whole paraffin-

stimulated saliva, collected at 11 A.M. from subjects starved several hours; enzyme activity was also measured in parotid saliva collected by means of Curby cup, and in submaxillary saliva collected with a Schneyer segregator, from these subjects after stimulation of the dorsum of the tongue with 1% acetic acid. Average peroxidase activity of whole saliva was found to be 1.198 ± 0.3004 mg. purpurogallin formed/ml. saliva. Parotid saliva activity averaged $125.1 \pm 19.6\%$, and submaxillary saliva $86.8 \pm 15.3\%$ of the activity of the whole saliva. Salivary peroxidase activity was inhibited by potassium cyanide, and by sodium fluoride and azide; loss of activity was rapid above 80°C and virtually complete above 90°C . The supernatants of centrifuged whole saliva averaged $9.9 \pm 6.7\%$ less activity than the whole saliva. The salivary peroxidase appears to be primarily of glandular origin, with a small thermostabile component possibly derived from hemoglobin. The average catalase activity of whole saliva was found to be 0.169 ± 0.0603 mEq perborate destroyed/ml. saliva; no catalase activity was found in uncontaminated parotid or submaxillary saliva. The supernatant of centrifuged whole saliva averaged $36.6 \pm 16.0\%$ less activity than the whole saliva. Salivary catalase is considered to be primarily of bacterial origin.

Nicolas, J., 1906. APPARITION DE LA VIRULENCE DANS LA SALIVE MIXTE DES ANIMAUX RABIEUX [Appearance of virulence in the mixed saliva of rabid animals]. *Compt. rend. de la Soc. de Biol. (Paris)*, 60 (13): 625-626.

Virulence of saliva in rabies-infected test animals (goats, rabbits, dogs) appeared simultaneously with the fever.

Niedermeier, W., R. E. Stone, S. Dreizen, and T. D. Spies, 1955. EFFECT OF 2-ACETYLAMINO-1, 3, 4-THIADIAZOLE-5-SULFONAMIDE (DIAMOX) ON SODIUM, POTASSIUM, BICARBONATE AND BUFFER CONTENT OF SALIVA. *Proc. Soc. exper. Biol. Med.*, 88 (2): 273-275.

Determinations were made of the Na, K, HCO_3 , and buffer capacity of paraffin-stimulated samples of saliva from 5 normotensive and 6 hypertensive subjects before and after daily oral doses of the carbonic anhydrase inhibitor, Diamox. Salivary samples were collected daily before breakfast and before brushing teeth. The divided doses of Diamox ranged from 0.5 to 1.5 gm. daily for a minimum of 2 weeks. Results show this administration of Diamox to produce a marked reduction in the rate of flow and in all the salivary components except K, which showed no appreciable change. The mean sodium level in the normotensive subjects dropped from 29.6 to 23.6 mEq/L. and in the hypertensive group from 24.7 to 18.2 mEq/L. The mean HCO_3 level in the normotensive group decreased from 20.4 to 13.8 mEq/L., and in the hypertensive group from 15.7 to 11.3 mEq/L. These salivary changes were found to be similar to those following metabolic acidosis, induced in 5 normotensive subjects administered 3 to 9 gm. of ammonium chloride daily in divided doses.

Niedermeier, W., S. Dreizen, R. E. Stone, and T. D. Spies, 1956. SODIUM AND POTASSIUM CONCENTRATIONS IN THE SALIVA OF NORMOTENSIVE AND HYPERTENSIVE SUBJECTS. *Oral Surg. Oral Med. Oral Pathol.*, 9 (4): 426-431.

Salivary concentrations of Na and K were determined in the resting and paraffin-stimulated

salivas of 79 subjects, including 42 normotensive persons having a mean age of 53 years, and 37 hypertensive patients having a mean age of 57 years. The time required to obtain 1.5 ml. of saliva was recorded during the 16-minute collection period before breakfast and before brushing teeth; flame photometric determinations of Na and K were calculated as mEq/L. Results show a significantly lower mean Na concentration in the salivas of the hypertensive group than in salivas of the normal group. Normal unstimulated and stimulated salivas had respective means of 11.2 ± 5.5 mEq and 23.9 ± 11.1 mEq; unstimulated and stimulated salivas of the hypertensive group had respective means of 7.4 ± 4.1 mEq and 14.9 ± 8.3 mEq. Considerable overlap in individual values of salivary Na are noted between the two groups. No significant group differences were found in salivary rate of flow or in K concentration. The salivary Na and K levels in the normal and in the hypertensive subjects were not materially affected by 3 to 9 gm. daily diet supplements of NaCl or KCl during a 3 to 6 day period.

Nikiforuk, Gordon, 1954. REDUCING PROPERTY OF SALIVA TOWARDS SOME OXIDATION-REDUCTION INDICATORS. *Jour. Dental Res.*, 33 (5): 677-678.

Saliva reduces redox dye-indicators whose E° (potentials of half-reduced dyes at pH 7.0) is more positive than -0.20 v. The reduction rate of equimolar solutions of some dyes is shown by the following series, in decreasing order of activity: toluene blue, methylene blue, 2, 3, 5 triphenyl tetrazolium chloride, cresyl violet, and safranin (only slightly reduced). The salivary fraction exhibiting reduction properties is associated with the insoluble sediment; a significant correlation exists between the amount of salivary sediment and its reducing coefficient. The reducing capacity of saliva is decreased 50% by addition of 4.2×10^{-5} M Furacin, 1.3×10^{-4} M iodoacetate, and 7.3×10^{-6} M cyanide. Sodium fluoride and penicillin had no effect on the reducing capacity; no apparent effects were produced by addition of glutamate, succinate, or formate. The reducing coefficient of saliva, having a broad pH optimum between pH 7 and 8, is not sharply influenced by pH. (From author's abstract).

Nikiforuk, Gordon, M. A. Cox, S. R. Jackson, and R. M. Grainger, 1955. SOME NONPROTEIN NITROGEN CONSTITUENTS OF BLOOD AND SALIVA AND THEIR RELATION TO DENTAL CARIES. *Jour. Dental Res.*, 34 (5): 716.

In a study of the interrelationships between blood urea, salivary urea, ammonia, and their effects on dental caries, a microanalytic method was developed for the determination of urea in 0.2 ml. of blood. Analysis was made of blood and of saliva from 94 7-year old children and from 40 caries-free children as to annual caries increment, blood urea, salivary urea and ammonia, as well as the rate of ammonia production and urea disappearance in saliva after 2 hours incubation.

Statistical analysis indicated highly significant correlations between the blood urea nitrogen and both salivary urea nitrogen, and salivary urea plus ammonia nitrogen. There is no significant relationship between salivary ammonia nitrogen and blood urea or salivary urea nitrogen. There is no significant relationship between the blood urea, salivary urea, or salivary ammonia, and the DMF index or the annual caries increment. (From author's abstract).

Niriforuk, Gordon, 1956. THE REDUCING PROPERTY OF SALIVA TOWARD SEVERAL OXIDATION REDUCTION INDICATOR DYES. Jour. Dental Res., 35 (3): 377-384.

The rate of salivary reduction of several redox indicator dyes was studied in tubes containing 0.5 ml. of paraffin-stimulated saliva, 0.5 ml. of 0.5 percent dibasic sodium phosphate and 0.5 ml. of .0005 M of a dye, mixed with 0.5 ml. of liquefied 2 percent agar adjusted to pH 7.1. The mixture was solidified and determination made of the salivary reducing coefficient (R.C.) which was calculated as the reciprocal of the time in minutes required to produce 90 percent dye decolorization at 37°C. Tests of the salivas of 12 persons showed the R.C. x 100 for the following dyes in descending order: toluene blue, 5.92; methylene blue, 4.10; 2,3,5, triphenyl tetrazolium chloride (15 to 60 minutes); cresyl violet, 3.00; and safranin (slight reduction after 10-15 hours of incubation).

The R.C. x 100 of paraffin-stimulated salivas from 114 children, 7 to 10 years of age, ranged from 0.4 to 10.7 and had a mean of 2.6; these values do not fit a normal probability distribution curve. The mean R.C. value for salivas from 29 caries-free children, 12 to 15 years of age, was 3.01 ± 0.59 ; the R.C. mean for an equivalent random control group was 2.85 ± 0.48 . Tests of the effect of inhibitors on the R.C. of saliva showed 4.2×10^{-5} M Furacin, 7.3×10^{-6} M cyanide, and 1.3×10^{-4} M iodoacetate to decrease the coefficient 50 percent at pH 7. Sodium fluoride, penicillin, and urethane had no inhibitory effect. No demonstrable effect on the coefficient was produced by lactate, glutamate, succinate, citrate, or formate in concentrations of .001 M, pH 7.1. Tests of the effect of pH using a phosphate buffer, on the R.C. of a pooled sample of saliva showed a broad optimum between pH 7 and 8.

Boiling or Seitz-filtration of whole saliva removed its ability to reduce the indicator dyes. Salivary sediment, from saliva permitted to stand at room temperature for 30 minutes, had about 60 percent of reduction ability of the saliva; sediment from saliva, centrifuged for 15 minutes at 3300 r.p.m., had about 70 percent of such activity. A positive linear correlation was found between total sediment in salivary samples and the corresponding R.C. values, indicating the reducing fraction to be associated with the solids present in the saliva.

Nikitin, A. I., 1948. NEKOTORYE DANNYE O VLIIANII IZMENENNOI REAKTIVNOSTI ORGANIZMA NA SEKRETSIIU PISHCHEVARITEL'NYKH ZHELEZ [Some data on the influence of changed reactivity of the organism on the secretion of the digestive glands]. Trudy Ob"edinennoi Sessii posv. 10-letiiu so dnia smerti I. P. Pavlova, Moscow: 256-260. Abstr.: Sovet. med. refer. Obozrenie, Fiziol., 1949 (4): 94.

The influence of changes in organic reactivity in digestive (including salivary) secretion as a result of horse-serum injection was studied in fistulated dogs. The serum itself (at 0.1 to 1.0 ml./kg. weight) did not elicit secretion in the digestive glands but it raised their state of stimulation. An increase in the dosage or repeated injections after this raise induced a decrease in the digestive secretions. The secretions of the gastric, pancreatic and intestinal

glands are described. The changes in the digestive glands are the more pronounced, the higher their position in the digestive tract.

Nikolaev, O. V., 1929. O VLIIANII GORMONOV NA FUNKTSIIU ISOLIROVANOI SLIUNNOI ZHELEZY [On the influence of hormones on the function of the isolated salivary gland] Zhur. eksper. Biol. Med., Moskva, 12 (32): 183-193.

Study was made of the effects of various endocrine extracts on the isolated canine submaxillary gland perfused with Ringer-Locke solution. Ninety-four experiments were made in 23 glands to determine salivation rate and vascular condition of the gland after injections of adrenalin, pituitrin, thyroid extracts, insulin, human testes and human ovarian extracts, epiglandol, goiter gland preparation, or paratidin. All tests made with various brands of adrenalin at 10^{-5} to 10^{-8} concentrations show that weak, 2.5×10^{-7} , concentrations induce increased salivation and usually vasoconstriction in the gland; very weak doses (10^{-7}) produce vasodilation, while larger doses (10^{-5} to 2×10^{-6}) rapidly inhibit salivation. No direct relationship was found between salivary secretion and rate of blood flow in the gland; salivation continued to decrease even after vasoconstriction had started to abate. Eight tests using throidin of the Kharkov Organo-Therapeutical Institute showed a 10-50% decrease in salivation, and vasoconstriction in one case, to follow administration of the drug at 1:100; an increased salivation and 2 cases of vasodilation followed administration of a 10^{-3} concentration of the drug. Thirteen tests using thyroidea-opton-Merck showed intense salivation of 35-40 units/minute to follow administration of an optimal concentration of 2×10^{-4} ; 10^{-3} elicited a transitory increase of 35-60 units followed by depressed salivation; a concentration of 10^{-4} evoked a slight increase in salivation while a concentration of 10^{-5} had little effect. Concentrations of 2×10^{-4} to 10^{-4} produced a temporary 5-10% vasodilation in several cases while that of 10^{-3} produced a 5-50% vasoconstriction. Complete inhibition of salivation followed an increase in the KCl content of the R-L solution, even during action induced by 2×10^{-4} Thyroideaopton. Injections were made of insulin Hochst at 1:25 to 1:1000, the calcium concentration in the R-L solution being 1.9 mg.%. A concentration of 1:25 increased the salivary rate 6-fold without vaso-reaction; 1:200 evoked increased salivation followed by depression; 1:300 to 1:400 doubled salivation rate, while 1:1000 effected no change in secretion. Four tests with testicular extract at 1:5 decreased salivation and produced a 30-50% vasodilation. Ten tests with spermin Peliat at 1:50 to 1:10,000 effected a greater or lesser increase in salivation accompanied by a slight vasodilation in the gland. A small number of tests of ovarian preparations, epiglandol, thymus-opton, and paratidin were inconclusive. Variations were noted in the effects of nominally equal proprietary drugs.

Nikolaev, O. V., 1929. K VOPROSU OB IDENTICHNOSTI DEISTVIIA ADRENALINA I KALTSIIA. (SUKHOI OSTATOK I ORGANICHESKIE VESHCHESTVA SLIUNY PRI DEISTVII ADRENALINA I KALTSIIA.) [Concerning the identity of adrenalin and calcium actions. (Dry residue and organic matter in saliva during the

action of adrenalin and calcium]. Zhur. eksper. Biol. Med., Moskva, 13 (35-36): 121-125.

The effects of adrenalin and of calcium on canine submaxillary saliva, cannulated from the isolated gland, was studied in continuation of a previous study (Nikolaev, 1929). The gland was perfused with Ringer-Locke (R-L) solution and the saliva analyzed for organic matter, dry residue, and ash content. Four to 15 drops of saliva were collected during the 2 to 4.5 hour experimental periods when calcium or adrenalin was injected in R-L solution at about optimum concentrations. A drop in salivary dry residue was noted after injection of 4 to 8 cc. of 0.1M CaCl_2 /100 cc. of R-L solution; a maximum drop of 2.5 to 1.7% in salivary dry residue coincided with the maximum increase in salivation rate produced by the 8 cc. injection; the percentage of dry residue rose to 1.78 on decrease in rate of salivation. In tests of the effect of adrenalin, a preliminary injection of 2 cc. of the CaCl_2 solution evoked 6 drops of saliva containing amounts of dry residue decreasing from 1.32 to 0.76% over a three hour period; injection of adrenalin at a concentration of 2×10^{-7} , three hours after the calcium injection, rapidly increased percentage of dry residue to 2.01% and the organic content from 0.58 to 0.88%; the salivary organic matter decreased about an hour after adrenalin injection apparently due to glandular exhaustion. Injection of 4×10^{-7} adrenalin increased the salivary dry residue from an initial 1.18 to 2.81%. Increases in salivary organic matter and dry residue after adrenalin are greater in the intact submaxillary gland than in the isolated gland. Calcium-elicited saliva resembles chorda saliva while adrenalin-stimulated saliva resembles sympathetic saliva.

Nikolaeva, N., and N. Lagutina, 1941. O KOMPONENTAKH TSENTRAL'NOGO MEKHANIZMA PISHCHEVOGO I OBORONITEL'NOGO BEZUSLOVNOGO REFLEKSA SLIUNOOTDELENIIA [On the components of the central mechanism of the unconditioned food and defense reflexes of salivary secretion]. Fiziol. Zhur. SSSR, 30 (1): 140-144.

The nervous mechanism and the parotid/submaxillary (P/S) ratio of unconditioned salivary reflexes were studied in 3 old dogs and in 3 young adult dogs before and after castration. Rusk powder, milk, and dilute solutions of HCl and of quinine were used as unconditioned stimulants; the P/S rates were found to be specific for each stimulant. Salivary reflexes conditioned to various sound and light signals were established for each of these stimulants and the P/S value found to resemble the corresponding unconditioned reflex as its diminished copy. A variable decrease in submaxillary salivation and a generally reduced parotid salivation were noted in the old and castrated animals. The reduction in salivary flow was paralleled by an increase in salivary viscosity.

Nikolajev, O., 1929. DIE ROLLE DER IONEN UND ELEKTROLYTE IM PROZESSE DER SPEICHELSEKRETION [The role of ions and electrolytes in the process of salivary secretion]. Pflüger's Arch. ges. Physiol., 223 (1-2): 95-103.

The method for elaborating an isolated nerve-blood vessel-salivary gland preparation in liquidated dogs is discussed. The perfusion of the

salivary gland with Ringer-Locke solution resulted in the functioning of this organ for several hours. A slow salivation was observed even for 24-28 hours. The electrical stimulation of the chorda improved salivary secretion considerably. When calcium chloride or saline solution were added to the Ringer-Locke solution, salivary secretion increased but only when the ratio was not higher than 10 cc. 0.1 mol. CaCl_2 in 100 cc. nutrient solution. The addition of more NaCl, KCl, and MgCl_2 to the solution inhibited the secretion. Additional CaCl_2 and HCl caused contraction of the glandular vessels, while NaCl caused a dilation of the same. The effect of MgCl_2 was inconstant but, in most cases, it contracted the blood vessels.

Nikolajev, O. W., 1931. UBER DIE WIRKUNG VON K-, UND Ca-IONEN AUF DIE FUNKTION DER ISOLIERTEN SPEICHELDRÜSE MIT DEGENERIERTEN NERVEN [On the effect of potassium- and calcium ions on the function of the isolated salivary gland having degenerated nerves]. Pflüger's Arch. ges. Physiol., 223 (6): 689-693.

The chorda tympani and the periarterial sympathetic nerve of dogs were severed and the salivary gland isolated. The test was undertaken on the assumption that a certain degeneration of the nerves involved took place during the survival period (the time between surgical intervention and liquidation of the animals, varying between 6-30 days). Half an hour after death had set in, the gland was perfused with Ringer-Locke solution. Test results indicated that an increase in CaCl_2 concentration (6 cc. 0.1 mol. CaCl_2 solution in 100 cc. R.-L. solution) of the Ringer solution, perfusing the vessels of the isolated salivary gland, improved salivation; an increase in concentration of KCl (10-20 cc. 0.15 mol. solution in 100 cc. Ringer-Locke solution) resulted in a decrease in salivation. In both cases a contraction of blood vessels set in. The effect of the Ca and K ions on the isolated gland having degenerated nerves was similar to that of the same ions on the normal isolated salivary gland.

Noback, Charles R., and William Montagna, 1947. HISTOCHEMICAL STUDIES OF THE BASOPHILIA, LIPASE, AND PHOSPHOTASES IN THE MAMMALIAN PANCREAS AND SALIVARY GLANDS. Amer. Jour. Anat., 81 (3): 343-364.

Histochemical studies (in rats, mice, and humans) were made of the basophilia, lipase, alkaline phosphatase, and acid phosphatase contents of the pancreas, submaxillary, parotid, and sublingual glands during their secretory phases and after the injection of pilocarpine. The basal and apical portions of the cells, the nuclei, the nucleoli, the perinuclear membranes, and the luminal contents and epithelia of the ducts were microscopically observed and evaluated as to their staining reactions. A detailed description of the histochemical techniques used is given, as well as a comparative discussion of previous literature and results obtained in this experiment.

Among the several conclusions stated, it is mentioned that the salivary glands (especially the serozymogenic cells of the submaxillary glands) contain and secrete both alkaline and acid phosphatase. It is suggested that basophilia

reactions are representative of or analogous with ribonucleoprotein staining reactions.

Noé, Joseph, 1895. LA PERMÉABILITÉ RÉNALE ET SON INFLUENCE SUR L'ÉLIMINATION SALIVAIRE [Renal permeability and its influence on salivary elimination]. *Compt. rend. de la Soc. de Biol. (Paris)*, 47 (5): 95-97.

A comparison was made of the saliva of a patient with polyuresis with that of one suffering from oliguresis. In the polyuretic, elimination of potassium iodide in the saliva began 1 hour after ingestion and continued for 38 hours; the oliguretic began this elimination sooner, after 3/4 hour, and continued it longer, for 55 hours. The iodide was present in the urea of the polyuretic 1-1/4 hours after ingestion and continued for 40 hours. Whereas in the oliguretic it appeared later (2 hours) and continued longer, (52 hours). The author concludes that the beginning and duration of salivary elimination of potassium iodide were functions of renal permeability.

Nolte, A. G., 1904. THE IDENTIFICATION OF THE MOST CHARACTERISTIC SALIVARY ORGANISM, AND ITS RELATION TO THE POLLUTION OF AIR. *Ann. Missouri Bot. Garden*, 1 (1): 47-80.

The organisms most characteristic of saliva, air, and skin surface were identified and compared, and the following were noted: form of individual cell, cell grouping, chromogenesis, production of indol, nitrate reduction, liquefaction of gelatin, and the action on sterile certified milk, lactose, saccharose, mannite, salicin, inulin, sorbite, raffinose, and rhamnose. It was observed that the most characteristic salivary cocci produce acid in lactose, and acid and clot in milk.

The pollution by salivary cocci of streetcar, theatre, 5 and 10 cent store, and outdoor atmospheres were determined, and it was found that in the majority of cases where ventilation is inadequate, characteristic salivary cocci can be isolated.

Nolte, William A., and S. S. Arnim, 1953. IN VITRO CHANGES IN pH OF THE DENTAL PLAQUE AND SURROUNDING SALIVA. *Jour. Dental Res.*, 32 (5): 674.

"In vitro studies with glass electrodes reveal pH changes of dental plaque when dextrose is added. A drop in hydrogen ion concentration from pH 7.0 to pH 4.4 occurs quickly. When the electrode is surrounded by saliva of pH 7.0 the drop in plaque pH occurs in spite of the presence of the saliva. Tests of the surrounding saliva taken simultaneously with that of the plaque reveal no drop in salivary pH when 50 cc. is used. If only 1 cc. of saliva is used to surround the plaque, the pH of this saliva also drops with the plaque pH. Samples of saliva from around the plaque on teeth in the human mouth indicate a like drop occurs in the pH of mouth saliva adjacent the dental plaque to which dextrose has been added. (Author's abstract).

Nolte, Wm. A., and S. S. Arnim, 1956. IN VITRO CHANGES IN pH OF DENTAL PLAQUE MATERIAL AND SURROUNDING SALIVA. *Jour. Dental Res.*, 35 (1): 83-89.

Description is given of a twin glass-electrode technic used to simultaneously study the production

of acid by dental plaque material by means of a cup glass electrode, and study the related changes in the surrounding saliva by means of a second electrode suspended in the saliva near the first. A preliminary test showed plaque material, coated on the glass cup electrode and treated with 1 gm. dextrose prior to incubation, dropped from pH 5.7-7.0 to 4.6-5.0 within 10 to 20 minutes. When the plaque material was incubated with dextrose but surrounded by 50 cc. of stimulated saliva, the plaque pH dropped as before while the salivary pH remained steady or showed a slight rise in one case. Tests with smaller amounts of saliva (1 cc., 5 cc.) showed the characteristic pH drop in plaque material but two types of saliva. In the first group, 1 cc. salivary samples fell from initial pH values of 7.4 to 7.5 down to 5.9-6.5 within 2 hours of incubation; 5 cc. samples with initial pH values 7.1 to 7.7 dropped to 6.7 to 7.2. Controls (saliva, saliva-dextrose) showed no significant change during 2 hours incubation. In the second group, 1 cc. salivary samples dropped from an initial pH of 6.9 to 7.4 down to that of the plaque material (pH 5.0 or less) within 90 to 120 minutes of incubation; 5 cc. samples dropped from an initial pH of 7.1 to 7.7 down to 6.7-7.2. The saliva-dextrose controls showed a 0.5 to 1.0 pH unit drop within 2 hours of incubation.

Northup, David, 1935. THE SECRETORY METABOLISM OF THE SALIVARY GLANDS. *Amer. Jour. Physiol.*, 114 (1): 46-52.

The energy metabolism of the submaxillary glands was studied in dogs anesthetized with amytal. The two submaxillary glands were freed from their capsules and the duct of the gland chosen for stimulation was cannulated. The sympathetic and parasympathetic nerves to the glands were electrically stimulated simultaneously until the salivary secretion ceased. The exhausted and unstimulated glands were then removed, frozen in liquid air, and analyzed for glycogen, lactic acid, and creatine phosphate contents.

In 13 experiments stimulation of all the nerves to the gland produced an average of 23 cc. of saliva; in 4 experiments stimulation of the chorda tympani yielded 9.8 cc.; and in 5 experiments sympathetic stimulation produced 0.6 cc. of saliva (p. 48).

It was emphasized that the sympathetic secretion is "expensive" as to glycogen usage; the production of less than 1 cc. of sympathetic saliva gave a somewhat larger decrease (26.3%) in glycogen in the stimulated gland than did the secretion of approximately 10 cc. from the chorda tympani stimulation (16.1%).

Novi, V. A., 1951. DINAMIKA SLIŪNOTDELENIIÂ U CHELOVEKA [The dynamics of salivary secretion in man]. *Voprosy Fiziol.*, 1: 96-103.

Study was made of salivary changes induced by prolonged salivary secretion in 4 men. Eighteen experiments lasting 2 hours each and eleven lasting 5 to 6 hours were made; saliva was collected from the capped parotid duct, and the rate of salivary flow as well as the organic content and dry residue were determined. Results obtained after prolonged salivary secretion under uniform conditions showed periodic fluctuations in rate of flow in different subjects; variations of 5-minute samples from 0.1 to 0.5 ml., noted

in some subjects, were exceeded in others. A decrease in secretion rate and in organic matter of the saliva, appearing toward the end of the second hour of experimentation, are discussed and diagrammed. The gradual, steady decrease in rate of flow of saliva stimulated by the same stimulant, soft fruit candy, dropped 60% after 4 to 5 hours secretion; total secretion after 5 hours was 9.8 ml. Digestion of another food, golden apples, caused an increase in flow rate. Alternation of food stimulants produced no diminution of secretion, even after many hours of salivation; no decreases were noted in dry residue or in organic matter, while in some cases increases in these salivary components were found. Two-hour tests repeated on three consecutive days showed a similarity of secretion curves and uniform dry residue content, indicating that the restoration of the salivary gland is complete after 24 hours. The author concludes that the decrease in the intensity of secretion and organic matter content after prolonged stimulation with one type of food is not the result of glandular exhaustion, but of a change in the receptor apparatus or in the central nervous system.

Novi, V. A., 1953. IZMENENIE SLIŪNOTDELENIIĀ PRI VVEDENII PILOCARPINA POD VLIĀNIEM VNESHNIK RAZDRAZHITELEI [Changes in pilocarpine-induced salivary secretion under the influence of external stimulation]. Vracheb. Delo, 5: 402-404. Sovet. med. refer. Obozrenie, 1954 (18): 95.

Salivary secretion elicited by injection of pilocarpine in dogs and in rabbits, was found to decrease in all experiments in which painful or interoceptive stimulation, or a 48-hour period of starvation was administered to the experimental animal.

Ockelmann, E., 1953. BEMERKUNGEN ZUR ARBEIT VON W. HOFFMEISTER UND A. ALBRECHT: "DIE SPEICHEL-ELEKTROLYTE UND IHRE DIAGNOSTISCHE BEDEUTUNG" [Observations to W. Hoffmeister and A. Albrecht's work: "The salivary electrolytes and their diagnostic importance"]. Klin. Wochenschr., 31 (47-48): 1116. 1953.

A criticism is made of the statistical procedure used in the cited salivary study (Hoffmeister et al, 1953); the conclusions are considered to be statistically invalid.

Ofstad, Birger, 1932. UNTERSUCHUNGEN ÜBER DAS HYPOPHYSENVORDERLAPPENHORMON IM SPEICHEL [Investigations on the anterior hypophyseal lobe hormone in saliva]. Klin. Wochenschr., 11 (42): 1761.

The salivas of 10 pregnant women were tested for the presence of the hormone of the anterior hypophyseal lobe; the mouse test of Ascheim-Zondek for urine was used.

In none of the 10 cases was there a positive pregnancy reaction; several of the mice exhibited a definite swelling of the uterus, and a hyperemia of the ovaries. Microscopic examination in all cases showed dioestrus. Controls consisting of the Ascheim-Zondek test of the urine of five women tested were all positive.

The author offers no positive conclusions, but states that the presence of the hormone in saliva, though in much less amounts than in urine, is indicated.

Oksman, I. M., 1935. K VOPROSU O VLIĀNII METALLOV, PRIMENIĀEMYKH V PROTEZNOI STOMATOLOGII, NA PTIALIN SLIŪNY [On the influence of metals used in prosthesis stomatology on the ptyalin of saliva]. Sov. Stomatologiya, 5: 97-99.

The influence of metals on the ptyalin of mixed saliva was studied. Weighed pieces of gold, platinum, silver, stainless steel, steel solder, chromated plate, Randolph copper, and others were left in contact with saliva during varied periods of time (5 min. to 4 days) at 30 to 40°C. and in the cold, or the saliva was taken directly from a mouth having metal prosthesis. The amylolytic action of the saliva was tested by the Wohlgemuth procedure; the pH of saliva determined by Michaelis' colorimetric method.

The results of 150 experiments definitely showed that all metals affect the fermentative action of saliva. After a short contact with the metals (5 to 10 min. or less), the amylolytic power is increased; after a prolonged contact it is always decreased, even in the case of 88-assay gold. The greatest decrease was observed in the case of Randolph, which thus appears to be the most harmful of the metals. The decrease for stainless steel is not greater than that for gold.

The author explains this influence of the metals on biological media by their oligodynamic action.

Oldfeldt, Carl-Olof, 1936. PHYSIKALISCH-CHEMISCHE UNTERSUCHUNGEN AN EINIGEN MUCINEN UND MUCOIDEN [Physico-chemical investigations on some mucins and mucoids]. Hoppe-Zeyler's Zeitschr. f. physiol. Chem., 240 (4-6): 249-260.

The electrochemical properties of several glycoproteids (i.e., mucins of the umbilical cord, cornea, vitreous humor, and submaxillary gland) were determined. Submaxillary mucin had an iso-ionic point (P_{ah} when $pH = P_{ah} - Py$; according to Cohn and Berggren, Jour. gen. Physiol., Py - correction) of 3.40-3.45; solubility minimum in citrate buffer, 2.5 P_{ah} ; alkali combining affinity (g. in Mol $\times 10^{-5}$), 159; and acid combining affinity, 30.

Olevskii, M. I., 1947. VLIĀNIE KEFIRA NA SEKRETOVNUIŪ I MOTORNUIŪ FUNKTSII PISHEVARITEL' NOGO TRAKTA [The influence of kefir on the secretory and motor function of the digestive tract]. Biŭll. eksper. Biol. Med., Moskva, 23 (1): 14-17.

Comparison was made of the stimulatory effects on salivary secretion produced by kefir and by milk administered to 2 dogs having parotid and submaxillary fistulas. Kefir elicited a greater amount of both salivas than did an equal amount of milk during an equal period of time. Kefir-stimulated parotid saliva had a slightly higher organic content and lower ash content than milk-stimulated saliva; no regular differences were found in submaxillary saliva. The effects on gastric, bile, and pancreatic secretions are also reported.

Opal, Zdenka, and R. W. Harrison, 1943. COMPARATIVE STUDIES ON ORAL AND INTESTINAL LACTOBACILLI. Jour. dent. Res., 22 (3): 205-206.

Morphological, biochemical, and immunological studies are reported concerning the types of

lactobacilli isolated over a 6-week period from the salivas and stools of eleven children. (From author's abstract).

Orban, Balint, and J. P. Weinmann, 1939. THE CELLULAR ELEMENTS OF THE SALIVA AND THEIR POSSIBLE ROLE IN CARIES. Jour. Amer. dental Assoc., 26 (7): 2008-2017.

The saliva of two groups of individuals—caries-susceptible and caries-immune—was examined for cellular contents. A description is given of the cytological properties of epithelial cells and leukocytes which were observed in both salivas. The salivas of caries-immune persons generally contained fewer leukocytes and more epithelial cells than those of caries-susceptible persons. The epithelial cells of caries-immune salivas were covered with microorganisms, whereas the other group was relatively bacteria-free; the bacteria were believed to belong to the Micrococcus catarrhalis, [Neisseria c.], Staphylococcus albus [Micrococcus pyogenes v. albus], and Streptococcus viridans [S. mitis] types. The leukocytes in immune saliva were, as a whole, more degenerate than those in caries-susceptible saliva.

Orban, B., and J. P. Weinmann, 1939a. CELLULAR ELEMENTS OF SALIVA AND THEIR POSSIBLE RÔLE IN CARIES. Jour. dental Res., 18 (3): 258.

"The presence of epithelial cells and leukocytes is demonstrated in saliva. The epithelial cells sometimes show loss of their cytoplasm which is most probably due to proteolytic activity. Sometimes the nuclei of the epithelial cells are missing which is due to hornification. The leukocytes show different stages of degeneration. In caries-immune individuals the epithelial cells have been found to be overgrown by bacteria. The number of leukocytes has been low. In caries-susceptible individuals the epithelial cells showed no or only few bacteria, while the number of leukocytes was mostly high." (Complete paper.)

Osborn, T. W. B., J. N. Noriskin, and J. Staz, 1937. A COMPARISON OF CRUDE AND REFINED SUGAR AND CEREALS IN THEIR ABILITY TO PRODUCE IN VITRO DECALCIFICATION OF TEETH. Jour. dent. Res., 16 (3): 165-171.

Sections of teeth were incubated in saliva-containing media, obtained by rinsing the mouth with normal saline or by chewing various food substances, to study dental decalcification. All mixtures reached a pH of 4 to 5 within 24 hours of incubation. Presence of a protective substance in crude sugar or cereals appeared to be removed by refining processes.

Osborne, Doris G., Howard M. Hackedorn, and Marshall L. Snyder, 1951. FORMATION OF MUCINOUS POLYSACCHARIDES FROM SUCROSE BY ORAL BACTERIA. Jour. dental Res., 30 (2): 302.

"Preliminary work was carried out with the S20B strain of Streptococcus salivarius to establish procedures for isolation and analysis of polysaccharides formed from sucrose. Amounts of levans were markedly increased by twice daily neutralization of the 5 percent sucrose broth cultures. Maximum yields of this polysaccharide were thus obtained within 48 hours. About half the fructose contained in the sucrose was converted to the levan. The balance was probably utilized for the energy requirements of the culture. Oral strains of streptococci which produced

different mucinous colony types on sucrose agar were studied in respect to levans. Fifty strains obtained from 30 children were surveyed for this synthesis. All but one of these strains produced levan in significant amounts." (Complete paper.)

Oster, Robert H., L. M. Proutt, B. R. Pollack, and E. R. Shipley, 1953. SALIVARY BUFFERING CAPACITY MEASURED IN SITU IN RESPONSE TO THE ACID STIMULUS FOUND IN SOME COMMON BEVERAGES. Jour. Dental Res., 32 (5): 676.

Salivary pH determinations were made in 195 individuals, using in situ electrodes, before and after consumption of approximately 3 ounces of a common carbonated beverage. Readings of the stimulated saliva were started 12 seconds after ingestion and continued at 20-second intervals until the pH returned to a value equivalent to, or more alkaline than the average normal reading. There were 385 experiments, averaging 10 pH readings per run, on ten carbonated beverages (average pH 3.0), a stimulated beverage (pH 7.0), and a water control (pH 7.2). The range of "resting" values was 5.73 to 6.15, normally distributed, with an average of 5.97, standard deviation 0.40, standard error 0.022. The pH shift toward alkalinity taken as buffering capacity, showed a significant difference in the slope of the curve over the 2-minute period. The average curve of increasing alkalinity versus time on ten test beverages showed a difference from the control curve of more than four times and standard error. Any difference greater than two times the S. E. indicates a significant change. The short time required for this buffering control after ingesting acid beverages is surprising; even more impressive is the fact that more than 50 percent of the 385 runs showed this positive buffering effect in 12 seconds. (From author's abstract)

Ovchinnikov, B. A., 1934. IZUCHENIE VEGATIVNOI NERVNOI SISTEMY U ZHELUDUCHNO-KISHECHNYKH BOL'NYKH [Study of the vegetative nervous system in gastro-intestinal diseases]. Terapevt. Arkh., 11 (5): 9-22.

The salivary secretion was used as an indicator in a study of the vegetative nervous system in cases of gastro-intestinal diseases. The saliva was collected by the Krasnogorskii-Iushchenko method from Stensen's duct after unconditioned or pilocarpine stimulation. The amount of saliva and its albumin content were registered. Spontaneous salivation was first registered before breakfast, then the salivary secretion elicited by 20 gm. of rusk or 25 gm. of sour cranberry and collected during three periods of 15 min. each. Several days later, the spontaneous saliva was again collected, then 1 cc. of a 0.5% pilocarpine solution injected subcutaneously, and the saliva collected during 1 hour in 4 samples. In one case 1 cc. of adrenalin (1:1000) was also injected concurrently with stimulation by cranberry.

Observations in one patient reveals: After stimulation by cranberry, salivation and albumin content increased. After injection of adrenalin and simultaneous cranberry stimulation, there was equally abundant salivation, and the albumin content was double of the amount after cranberry stimulation alone. After injection of pilocarpine, salivation was increased double of that elicited by cranberry stimulation, with a parallel increase in albumin. Thus, adrenalin increases sympathetic

salivation, which is rich in albumin; pilocarpine stimulates both the parasympathetic and sympathetic salivation.

Results of 130 experiments conducted in 65 gastro-intestinal patients revealed five groups, differing in salivary secretion in response to pilocarpine stimulation in regard to quantity and albumin content. These groups were tested by physical methods for the symptoms of Preval, Ashner, the general pilomotor and solar reflexes, etc. A description of the diseases pertaining to the patients of these groups is further given.

Comparing the salivary data with those of the physical examination of the vegetative nervous system, the author concludes that an accurate measurement of salivary secretion and determination of its sympathetic or parasympathetic origin is an expedient method of determining the tonus of the vegetative nervous system in cases of gastro-intestinal diseases with analogous results.

Ovchinnikov, B. A., A. V. Shcheglova, and A. A. Shaltalova, 1935. IZUCHENIE DEIATEL'NOSTI SLI-ŪNNYKH ZHELEZ I SOSTAVA SLIŪNY U ZHELUDOCHNO-KISHECHNYKH BOL'NYKH [Study of the activity of the salivary glands and composition of saliva in gastro-intestinal patients]. *Terapevticheskii Arkhiv*, Moskva, 13 (1): 25-32.

The composition of saliva was studied in 124 gastro-intestinal patients. The saliva was stimulated by sour cranberry, crushed rusk or pilocarpine, and collected by the Krasnogorskiĭ-Iŭshchenko method from Stensen's duct; 210 experiments were made, 145 with food stimulation, 65 with pilocarpine. Tests included: determination of the pH (Michaelis' method), titrable acidity, albumin (Spigler-Ioless), general nitrogen (micro-Kjeldahl), organic compounds (O. S. Manielova), thiocyanates (Autenrith-Funk), viscosity (Hess), chlorides (Bang), and amylase (Wohlgemuth). The measurements were made in 4 salivary samples collected before breakfast, during the food stimulation, and 15 and 30 min. after it; with pilocarpine stimulation, 4 samples were collected during 1 hour.

Results of the experiments lead the author to the following conclusions: before breakfast, a slight spontaneous parotid salivation is usually observed when the collecting caps are applied, ceasing soon afterward. This saliva usually has an acid pH reaction (pH 5.7 to 6.1; average 5.8 to 5.9) which becomes rapidly alkaline under food stimulation.

In response to sour cranberry, salivary secretion is greatest with highest alkalinity and minimal nitrogen content, regardless of disease or acidity of gastric juice.

Rusks elicit a somewhat smaller amount of saliva with a less alkaline reaction and smallest albumin content.

Pilocarpine elicits a comparatively smaller amount of saliva with almost neutral reaction, high albumin, nitrogen and thiocyanates content, and of greatest viscosity. The pilocarpine salivary reaction depends on the tonus of the vegetative nervous system.

Patients with gastric or duodenal ulcer secrete before breakfast a small amount of saliva which is rich in chlorides; food stimulates greatly increased, highly alkaline saliva (.. to ..). In response to pilocarpine, the saliva is richer in albumin and nitrogen than in response to food.

In gastritis patients, the stimulated saliva is more viscous and richer in albumin and nitrogen, especially in cases of hyperacidity than occurs under normal circumstances. With normal gastric acidity, salivary reaction is more normal, depending on the nature of the stimulant. Salivary secretion before breakfast is greatest in gastritis with absence of acidity.

Owen, Olin W., 1949. A STUDY OF THE BACTERIAL COUNTS (LACTOBACILLI) IN SALIVA RELATED TO ORTHODONTIC APPLIANCES. *Amer. Jour. Orthodont.*, 35: 672-678.

A preliminary study indicates a direct relationship between the presence of orthodontic appliances and increased lactobacilli counts in the mouth, a direct correlation existing between the numbers of lactobacilli per cc. of saliva and the total number of band-months.

Pack, George T., 1923. NEW EXPERIMENTS ON THE NATURE OF THE SENSATION OF THIRST. *Amer. Jour. Physiol.*, 65 (2): 346-349.

Rabbits, fasted from food and water for 7 days, were given subcutaneous injections of pilocarpine (0.5 cc. of 1% solution/kg. body weight). Controls were injected with water. The rabbits, salivating from pilocarpine, either refused to drink or in 2 cases drank 15 and 25 cc. of water within an hour. The controls drank from 62 to 137 cc. within the first half-hour. Thirst is interpreted as a relative drying of the mucous membrane of the mouth and pharynx; pilocarpine relieves thirst by stimulating the flow of saliva.

Pagliai, Gino, 1910. IL POTERE DIASTATICO DELLA SALIVA MISTA NEI DIVERSI STATI PATOLOGICI E SPECIALMENTE NELLE MALATTIE DELLO STOMACO [The diastatic power of mixed saliva in various pathological states and specially in diseases of the stomach]. *Riv. crit. di Clin. med.*, 11 (16): 241-247.

Literature on the amylolytic activity of human saliva is reviewed. The author demonstrates that in normal subjects the rate of salivary secretion as well as the diastatic activity of the saliva fluctuate with relation to ingestion of food, both being highest during and after a meal. In advanced age, salivary secretion rate and amylolytic power of the saliva decrease; in acute febrile diseases and in cachectic conditions, the amylolytic activity of the saliva is diminished; in various diseases of the stomach, however, it is generally not altered. 21 ref.

Palawandow, Haidar, and A. I. Serebrennaja, 1930. ZUR FRAGE DER VIRULENZ DES SPEICHEL VON AN TOLLWUT ERKRANKTEN MENSCHEN [On the question of the virulence of saliva of rabid humans]. *Zeitschr. f. Immunitätsforsch.*, 68 (3/4): 236-242.

The presence of the rabies virus in the saliva of rabid man was established by guinea-pig inoculation tests.

Palawandow, H., and A. I. Serebrennaja, 1931. UEBER DAS WUTVIRUS IM MENSCHLICHEN SPEICHEL. III. [On the rabies virus in human saliva. III]. *Zeitschr. f. Immunitätsforsch.*, 71 (3/4): 350-351.

The salivas of three rabid persons were shown, by animal inoculation, to be definitely virulent. Infection of laboratory animals necessitates the

intramuscular injection of not less than 2-3 cc. of saliva from a diseased person, whereupon the animal is to be kept in a cool room and on restricted nourishment.

Palmer, C. C., 1916. THE DIASTASE IN THE SALIVA OF THE OX. *Amer. Jour. Physiol.*, 41 (4): 483-491.

Eight saliva samples from six oxen were studied for diastatic activity by the iodine method. The samples were shown to possess a starch-splitting enzyme (or enzymes) which, however, acts much more slowly than its human counterpart. The enzyme is present in much greater concentration in blood; it is probably derived from thence and is not a normal salivary constituent. It is destroyed by heating at 65°C. for 1 minute. Its digestive abilities are questioned.

Palmer, C. C., A. L. Anderson, W. E. Peterson, and A. W. Malcomson, 1917. OROKINASE AND SALIVARY DIGESTION STUDIES IN THE HORSE. *Amer. Jour. Physiol.*, 43 (3): 457-474.

This experiment was subdivided into 4 parts. The first part was devoted to the study of the origin and function of orokinase, an enzyme which activates the saliva. The next portion of the work examined the bacteria of the mouth as activating agents. The amylolytic action of mixed saliva obtained from the mouth and esophagus was studied. Finally, the amount of complete starch digestion in the mouth was investigated. By studying the parotid fistula saliva of three horses, and the glycerine or water extracts of the parotid, submaxillary, and sublingual glands of 8 horses, the authors were able to demonstrate that saliva is inactive before it reaches the mouth. The parotid fistula saliva of 100 cases stimulated under natural conditions had no amylolytic activity upon cooked or raw starch within several hours. Glycerine and water extracts were also without action. In 11 horses, mixed saliva was taken from the mouth; and in 6, it was taken from an esophageal fistula. Raw corn and oats exposed to such saliva were heavily reduced. Studies of an extract isolated from the buccal portion of the mouth indicated that the isolate was an activator of saliva from the parotid fistula and the gland extracts from the 3 salivary glands. By itself, it would also digest starch. A few drops were determined to activate an indefinite amount of saliva if given enough time; boiling destroyed the activator. Anatomical dissection located the glands which secrete the activator under the mucous membrane of the cheeks and lips; extracts of these glands from 10 horses gave evidence of the activating substance. In order to demonstrate the presence of the activator, the tissue had to be fresh. The activator was called orokinase; it has been demonstrated in human saliva, also. Using bacterial cultures obtained on sterile swabs from the mouths of 5 horses, and grown on plain agar for 36 hours at 37.5°C., the authors failed to show salivary activation. In 17 horses, the amylolytic action of mixed saliva was shown to nearly equal that of human saliva. The saliva was difficult to collect, 5-10 cc. being the average amount obtained at one time. It was noted that a direct relation existed between the ease with which the saliva was collected and its digestive ability. Mixed saliva from esophageal fistulas indicated

that it had powerful amylolytic properties; secretions collected from 5 horses cleared starch solutions in 1-5 minutes; the blue color of iodine disappeared in the same time, and the reduction was very heavy. By way of comparison, the average activity of the mixed saliva from the mouth gave clearing of a starch solution in 15 minutes; however, some blue from the iodine was still present at the end of 2 hours, and only slight reduction was shown at the end of the clearing period. A diet of raw corn or oats fed to 6 horses showed heavy reduction with Fehling's solution when collected from esophageal fistulas in the animals. In an attempt to determine quantitatively the amount of sugar in the swallowed food of these animals, 5 horses were used in a test which involved converting the starch in the grains of a measured amount of corn or oats into sugar by the official government method. An equal amount of raw corn or oats was then fed to the test animal, the food mass was caught through the esophageal fistula as the horse swallowed it, dilute HCl was added to stop the enzyme action, and the amount of sugar produced was determined. This percentage was compared to the percentage produced by the wholly reduced corn, or oats. Results showed that .5-1 percent of the corn starch, and 1-2 percent of oats starch was digested in the mouth.

Pan, S. C., L. W. Nicholson, and Paul Kolachov, 1953. TRANSGLYCOSIDASE ACTIVITY OF AMYLASE PREPARATIONS. *Arch. Biochem. and Biophys.*, 42 (2): 421-434.

A method is described for measuring transglycosidase activity. The occurrence of the enzyme was noted and determined in the following: culture filtrates of molds, barley malt, whole human saliva, and commercial amylase preparations, bacterial cultures and pancreatic preparations. Transglycosidase activity was found to be high in the mold preparations, moderate in the pancreatic preparations, and slight in the bacterial cultures, but no trace of the enzyme could be detected in saliva.

Pastore, S., 1921. WIRKUNG DES SPEICHEL AUF DIE STÄRKE IN GEGENWART VON MAGEN- UND PANKREASSAFT [The action of saliva on starches in the presence of gastric- and pancreatic juice]. *Chem. Zentralbl.*, 923 (2): 184.

Amylolytic activity is studied in the presence of various concentrations of HCl NaOH, or of human or canine gastric and pancreatic juices.

Patten, Jane Boit, and Percy G. Stiles, 1906. ON THE INFLUENCE OF NEUTRAL SALTS UPON THE RATE OF SALIVARY DIGESTION. *Amer. Jour. Physiol.*, 17 (1): 26-31.

The influence of various neutral salts on the rate of salivary digestion of starch was studied *in vitro*; procedure is described in detail. Ptyalin was relatively unaffected by the presence of many salts in high, or even in saturated concentrations (magnesium sulphate, ammonium chloride). The salts of magnesium, calcium, and barium had accelerating effects, while those of ammonium, potassium, and sodium retarded digestion. Moderate amounts of lithium chloride almost completely inhibited the enzyme.

Pavlov, I. P., 1900. SOVREMENNOE OB"EDINENIE V EKSPERIMENTE GLAVNEISHIKH STORON MEDITSINY NA

PRIMERE PISHCHEVARENIÎA [Contemporary experimental union of the most important branches of medicine after the example of digestion]. (Lecture). Bol-nich. Gaz. Botkina, 11 (14-15): 617-641.

A general survey is presented of findings concerning salivary and other digestive secretions in the dog, investigated during physiological studies at the author's laboratory.

Pavlov, I. P., 1907. LEKTSIÎA O NOVYKH USPEKHAH V SVIAZI S MEDITSINOI I KHIRURGIEI" V CHESTI T. GEKSLI, CHITANNIÎA V CHARRING CROSS HOSPITAL MEDICAL SCHOOL V LONDONE, 1-G (N.ST.) OKTIABRIA 1906 GODA [Lecture "On new achievements in connection with medicine and surgery" in honor of T. Huxley, read at Charring Cross Hospital Medical School in London on Oct., 1906]. Izvestiia Imperatorskoi Voenno-Meditsinskoi Akademii, 14 (1), Jan., 1907: 1-20.

A general review is presented of the study of the conditioned reflex in the dog.

Pavlov, I. P., and M. K. Petrova, 1932. K FIZIOLOGII GIPNOTICHESKOGO SOSTOIANIÎA SOBAKI. [On the physiology of the hypnotic condition in the dog]. Trudy Fiziol. Lab. I. P. Pavlova, 4: 3-13.

Food reflexes under hypnotic conditions were studied in two dogs. After a description of negative and positive food reflex movements of the dogs, an account is given of the splitting of the secretory and of the motor food reflexes in response to a conditioned stimulus (rattle or bell), which assumes often the appearance of mutual antagonism. There is either salivary secretion and absence of reflex movement, i.e. the dog does not take the food, or the dog catches the food and eats it rapidly in complete absence of salivary secretion. The change from one moderate stimulus to another (rattle to bell, for example) either leaves the hypnotic state unchanged, or increases it. Sometimes, one reflex antagonism alternates rapidly with another, for example; to the sound of the rattle, there would be salivary secretion (10 drops/second) and motion away from food; to the sound of the bell which follows, the dog catches and eats the food at once, the salivary secretion remaining absent. Upon interpolation of a very strong conditioned stimulus (i.e. a ratchet-drill), the hypnotic state is either diminished or removed and the missing reflex reestablished.

The physiological mechanism of these phenomena is analyzed in the discussion.

Pavlov, F. S., 1938. USLOVNOREFLEKTORNOE OTDELENIE SLIŬNY OKOLOUSHNOI ZHELEZOI U TELIAT [Conditioned salivary secretion of the parotid glands in the calf]. Fiziol. Zhurn. 25 (4): 495-502.

Study was made of conditioned parotid secretion in two 1 month-old calves whose left gland had been fistulated. The normal standard salivation was determined before each experiment and during the feeding. About 100 experiments were made in animals either fed or starved for 18 hours.

Feeding with oats produced always an increase in secretion. Subsequent teasing with food (hay, milk and oatmeal) produced in an overwhelming majority of cases the same unconditioned reflex - a marked reduction in the uninterrupted parotid secretion. The length of the reaction varied.

After repeated teasing without the giving of food the unconditioned reflex would disappear, but could be reestablished by resumption of simultaneous feeding.

An indifferent stimulation was then added in the form of a bright light (100-watts lamp) or the sounding of an electrical bell, preceding the feeding by 5 sec. and accompanying it. After a number of experiments, conditioned reflexes were obtained in response to the indifferent stimulus alone. As a rule, the conditioned reflex determined a reduction of parotid salivation.

Experiments using alternatively a bright light (100 watts) and a blue light showed that a differentiation in parotid secretion could be obtained, as the conditioned reflex responded to one of the stimuli and not to the other.

Pavlov, F. S., 1939. USLOVNOREFLEKTORNOE OTDELENIE SLIŬNY PODCHELIUSTNOI ZHELEZY U TELIAT [Conditioned reflex salivary secretion from the submaxillary gland in calves]. Fiziol. Zhur. SSSR, 27 (1): 86-91.

Study was made of the influence of conditioned stimulation on submaxillary secretion in 2 fistulated calves, 10-15 days old, and the possibility of extinction or differentiation of the natural conditioned reflexes examined. Stimulants used were milk, oats, and chopped hay, mixed with bran and water. Stimulation was applied when the salivary gland was not secreting.

Milk always elicits submaxillary salivation; the secretion starts quickly, reaches a maximum during the first minute, then decreases either immediately or gradually, ceasing on the second or third minute. The amount of saliva secreted in response to 200 cc. of milk, drunk in 30 seconds, was 1 to 3 cc. The hay mixture elicited a secretion of 4 to 5 cc. in the first minute, which decreased to zero in the second or 3rd minute. Similar results were obtained for oats.

To establish conditioned salivation, the animal was first fed for 30 seconds and, after the cessation of secretion, then teased with the same food for another 30 seconds; this procedure was repeated at regular intervals. Results of numerous tests showed that the view and smell of food (oats or milk) always elicits less than half the submaxillary secretion stimulated by feeding.

To obtain the extinction of the conditioned reflex, repeated teasing without feeding was done. Only the 9th to 15th teasing brought about extinction of conditioned salivation.

Light applied as an indifferent stimulant, had no effect on salivary secretion. Applied in conjunction with food (oats or milk), a conditioned reflex was developed. Definite extinction of this reflex was obtained on the following day only. Then, the conditioned reflex could again be restored.

Differentiation of the conditioned reflex to ordinary light (100w.) and blue light (40 w.) could be worked out, and was stable.

Pavlova, Anna, 1935. VLIÎANIE USLOVNOGO REFLEKSA NA VELICHINU BEZUSLOVNOGO [The influence of the conditioned reflex on the value of the unconditioned]. Fiziol. Zhur. SSSR, 18 (5): 725-733.

Two series of experiments were conducted over a 7-month period in two dogs. Variations were effected in the feeding time of a normally 6-minute meal of meat and rusk in one series, while

different forms of conditioned stimulus were administered 20 seconds before a 6-minute feeding in the second series. Results showed that the total amount of saliva elicited by a meal was greater in the absence of prior conditioned stimulation. Unconditioned salivary flow was depressed to a greater extent by strong conditioned stimulation than by weak. Simultaneous application of conditioned and unconditioned stimulation had no effect on salivary response to food or to indifferent stimuli. The effects of the conditioned reflex on the unconditioned reflex is discussed.

Pawan, J. L., 1937. INFECTIVITY OF THE SALIVA IN PARALYTIC RABIES. *Ann. trop. Med. Parasitol.*, 31 (2): 267-270.

The salivas of rabid animals (6 bovines and 2 horses between 3-5 days of rabies, 6 humans between 2-4 days, and bats) were highly infectious, when rubbed superficially on the scarified abdominal wall of rabbits. No case of rabies, however, has been recorded among peasants and stock-owners who habitually scoop out the frothy mucus from the mouths of affected animals with their bare hands upon which superficial wounds can be seen.

Pazur, John H., 1953. THE HYDROLYSIS OF AMYLOTRIOSE AND AMYLOTETRAOSE BY SALIVARY AMYLASE. *Jour. biol. Chem.*, 205 (1): 75-80.

A study was made of the hydrolytic action of purified salivary amylase (prepared from human saliva) on amylotriose (maltotriose) and on amylo-tetraose (maltotetraose) under identical conditions of temperature, pH, and concentration of enzyme and substrate. The specific rotation, molecular weight, and chromatographic mobility of the end products were determined, and the relative rates of the hydrolysis of the α -1,4-glucosidic bonds were calculated.

The hydrolysis of amylotriose by salivary amylase produced equal molar concentrations of glucose and maltose, however, amylo-tetraose was primarily hydrolyzed to maltose and only slightly to glucose and amylotriose; glucose production was not attributed to maltase activity. It is concluded that the terminal glycosidic bonds of the amylo-oligosaccharides, amylotriose and amylo-tetraose, are susceptible to the hydrolytic action of salivary amylase.

Pazur, John H., and Tania Budovich, 1955. HYDROLYSIS OF AMYLOTRIOSE BY CRYSTALLINE SALIVARY AMYLASE. *Science*, 121 (3150): 702-703.

Highly purified salivary amylase was used to digest amylotriose through hydrolysis of the glucosidic bonds at the reducing and non-reducing ends of the trisaccharide molecule. Four mg. of amylotriose dissolved in 0.05 cc. of water, was treated with .05 cc. of a solution of the crystalline enzyme; the solution was buffered to pH 6.8 and contained 12 units of amylase activity per cc. Paper chromatographic analysis was made immediately, after 6- and 24-hours reaction time. The analyses showed considerable hydrolysis of amylotriose to glucose and maltose after 6 hours which was more than 75% complete after 24 hours. A similar experiment using filtered saliva, likewise containing 12 units of amylase activity per cc., revealed that at equivalent concentrations of amylase activity both the crystalline and crude enzyme preparations hydrolyzed the trisaccharide at the same rate. As neither preparation exhibited

any maltose activity the hydrolysis is considered to be effected by the amylase rather than by maltase or some other yet-unidentified enzyme in saliva. Another similar experiment using the crystalline salivary amylase and 1-C^{14} amylotriose revealed the glucosidic bonds to be susceptible to enzymolysis. A faster rate of hydrolysis is indicated for the glucosidic bond nearest the reducing end over the bond nearest the non-reducing end of the amylotriose molecule. The results of these experiments are considered to support the theory that alpha amylase action on starch and starch-like compounds proceeds from both the reducing and the non-reducing end of the molecule.

Peabody, William A., Ivan C. Hall, and Robert C. Lewis, 1927. BACTERIAL GROWTH AS A FACTOR IN THE DEPOSITION OF CALCIUM FROM SALIVA. *Dental Cosmos*, 69 (11): 1087-1094.

Pooled human saliva was tested periodically during incubation at 37°C. for pH, using colorimetric methods, and for dissolved calcium content by direct precipitation or ashing methods. The saliva was incubated in both tight (rubber)-stoppered and cotton-stoppered flasks. Saliva in the tight-stoppered flask showed a preliminary drop in pH from 7.3 to 6.4 after 15 hours of incubation, followed by a rise to 7.0 after 117 hours. During this period the dissolved calcium content dropped slowly from an initial 5.1 mg. per 100 cc. of saliva to 3.0 mg. Saliva in the cotton-stoppered flask dropped from the pH of 7.3 to 6.8 after 15 hours and then rose to a terminal 8.3 at 88 hours; the rise in pH was paralleled by a steady drop in dissolved Ca content to a trace at 88 hours. A similar sample, with 5% sucrose added, dropped in pH from 7.3 to 4.8 at 15 hours to a terminal 4.4 at 21 hours. Sterilized control samples remained constant in pH and dissolved Ca throughout incubation.

Pearce, R. G., 1916. THE APPEARANCE OF SUGAR IN THE SECRETIONS OF THE DIGESTIVE TRACT FOLLOWING THE ADMINISTRATION OF PHLORIDZIN. *Amer. Jour. Physiol.*, 40 (3): 418-425.

An investigation was made of the reducing power of pancreatic, gastric, and salivary secretions in normal and phloridzinized dogs. The normal submaxillary saliva was found to contain no appreciable amount of reducing substance. Traces were found in 4 of 9 dogs treated with phloridzin.

Peat, S., P. J. P. Roberts, and W. J. Whelan, 1952. THE OCCURRENCE OF FRUCTOSE IN RABBIT-LIVER GLYCOGEN. *Biochem. Jour.*, 51 (3): xvii-xviii.

Glycogen, from the livers of pregnant does, was used as a substrate for salivary alpha-amylase action; the end-products of the reaction were fractionated, and their chemical and physical properties were studied.

Pejrone, Giovanni M., 1935. STUDIES ON THE BUCCAL BACTERIAL INDEX IN EDENTULOUS MOUTHS. *Dental Cosmos*, 77 (8): 800-802.

Examination was made of the oral flora of 20 males and 30 females, all edentulous (67-86 years old), none showing inflammation of the buccal mucosa, none using prosthetic appliances. Blood agar plates were seeded with diluted mouth washings and the number of colonies per plate counted. The average number of colonies per plate for the

women, 137, is the lowest found by the author in any group of persons. The average for the men, 197, is close to the normal index, which is considered to vary from 200 to 1200 colonies per plate. The combined average, 161, shows diminution in the bacterial flora of edentulous mouths.

Pekker, P. IÂ., 1955. VLIIÂNIE DLITEL'NYKH RAZDRAZHENII PUL'PY ZUBA FORMALINOVOI PASTOI NA ROBOTU SLIÛNNYKH ZHELEZ [The influence of prolonged irritation of the dental pulp by formalin paste on the function of the salivary glands.] *Stomatologîia*, 1.: 10-23.

The effect on salivation of prolonged dental-pulp irritation caused by a formalin paste was investigated in 3 dogs; two dogs had a submaxillary fistula, and one had submaxillary, parotid, and gastric fistulas. Salivation was induced by subcutaneous injection of 0.2 ml. of 1% pilocarpine and samples collected every 5 minutes; in other tests saliva was evoked by feedings of 100 gm. of bread at 5 to 15 minute intervals and salivary samples collected in 2 minutes after a feeding. The upper third premolar tooth on the left side was trephined under anesthesia after control tests had been made, the coronary pulp amputated, and part of the pulp cavity filled with a fresh 40% formalin paste before closing the cavity with cement. Abundant spontaneous salivation from the fistula was noted during the operation; 161 tests were made after the operation. Results show that strong mechanical irritation of the dental pulp, under conditions of complete anesthesia, elicits a large reflex and pilocarpine salivation from the mixed glands. Chronic pulpar irritation with formalin paste disturbs normal salivation; the secretory changes show individual variation, apparently depending on the animal's nervous type. After prolonged irritation of the pulp, trophic disturbances appear.

Peluffo, A., 1929. ACTION LIPASIQUE DE LA SALIVE [lipase action of saliva]. *Compt. rend. Soc. Biol. (Paris)*, 100: 115-116.

A description is given of a stalagmometric test for a lipase [tributyrylase] in human and in canine saliva. The enzyme, tested under sterile conditions, is considered to be of salivary rather than microbial origin. Glycerine extracts of salivary glands in the dog also show the same lipolytic activity, that of the parotid gland appearing to a lesser degree than that of the submaxillary gland, the extract of which gland is very active. It is suggested that the lipase assists in clearing the mouth of fats.

Penrose, L. S., 1930. THE LYSOZYME CONTENT OF SALIVA IN PSYCHOTICS. *Lancet (London)*, 219 (5587): 689-690.

The lysozyme contents of the salivas of 32 persons (6 normal controls and 26 mental or organic psychotics) were compared. The salivas were collected at midday, three times over a 6 months' period, centrifuged, tested, and, at the end of the third testing, values were averaged; the criterion used was "the highest dilution of saliva giving rise to more than 7/8th lysis of standard buffered suspensions of *M. lysodeikticus* (two-day growth on agar) in one hour at 37°C." The degree of lysis was established by comparing the saliva-containing tubes with tubes containing barium sulphate suspensions of standard opacity.

Average values were: 6 normals, 1:292; 8 cases of dementia praecox, 1:267; 4 mental defectives, 1:242; 4 cases of mania, 1:211; 4 postencephalitic Parkinsonians, 1:128; and 6 general paralytics, 1:89.

No correlation between the lysozyme titer and age was established. When the titers of the two sexes were compared, the women usually had higher values than the men; the author attributes this to the smoking habit in men which tended to stimulate a watery saliva secretion.

In summation, no significant difference in salivary lysozyme content between the normals, mental defectives, and cases of dementia praecox was observed; however, a comparison of these with the values of organic psychotics indicated that in the latter the concentration was greatly diminished. A general relation between a low lysozyme content and a weak physical state was indicated.

Perla, David, and Jessie Marmorston, 1941. THE SKIN, MUCOUS MEMBRANES, AND SEROUS SURFACES IN NATURAL RESISTANCE. IN: NATURAL RESISTANCE AND CLINICAL MEDICINE, pp. 828-834. Boston, Little, Brown, 1941.

The chapter contains a section on the natural defenses of the oral cavity against infectious, even highly virulent organisms. The literature on the inhibitory factors of saliva, mucus, etc., is reviewed.

Permar, Dorothy, Paul C. Kitchin, and Hamilton B. G. Robinson, 1946. VARIATION IN COUNTS OF LACTOBACILLI MADE ON SINGLE SPECIMENS OF SALIVA. *Jour. dental Res.*, 25 (6): 475-486.

Recognizing the discrepancies in previous salivary lactobacillus counts, the authors ran a series of tests in an attempt to obtain consistent results. A series of 8 to 10 plate cultures from the same saliva sample bore out the inaccuracies.

Using extreme care in measurement, 39 series of plates were made from 39 saliva samples using 1 cc. of saliva in a measured amount of Jay's beef infusion broth (as diluent). 26% of the series gave all plates within the range $\pm 1/2$ the mean; 28% gave one-half or less within $\pm 1/2$ the mean. No more consistent results were obtained by manual shaking of saliva and diluent than by pipetting.

On the assumption that the use of larger portions of saliva would produce more consistent results, 5 cc. of the original saliva sample were shaken and removed to 5 cc. fluid agar for the first dilution. The mixture was beaten (high speed stirrer), a second dilution was made, and the specimen was plated. Using this method (described in greater detail) in 16 series of plates from 16 samples, 69% gave all plates within the range $\pm 1/2$ the mean; 6% of the series had one-half or less of the plates within $\pm 1/2$ the mean.

All methods used gave some unsatisfactory results; wide variations occurred in all series.

Permar, Dorothy, and Paul C. Kitchin, 1949. PROCEDURE IN A CARIES CONTROL LABORATORY. *Oral Surg.*, 2 (8): 1008-1014.

The method used by the Ohio State University Dental Caries laboratory to count colonies of *Lactobacillus acidophilus* is presented. The methods for collection of saliva, dilution of the specimen, and spreading on the plate are described. Inaccuracy of the counting method allows

only trends of high, medium, or low counts to be established.

Pesch, , 1936. ÜBER DEN EINFLUSS VON SPEICHEL AUF VIRULENTE PNEUMOKOKKEN [The influence of saliva on virulent pneumococci]. *Klin. Wochenschr.*, 15 (7): 255.

Fresh, filtered or heat-deactivated saliva, collected from 5 subjects whose mouths had shown absence of pneumococci, was seeded with virulent pneumococci [*Diplococcus pneumoniae*] of types I and II and then serially transplanted on blood agar for 10 days. Loss of virulence to white mice was noted in such cultures incubated at 37°C. Repeated transfer of the pneumococci in fresh salivary samples produced no apparent change in serological type.

Pesch, Karl L., Rolf Dammn, 1936a. ÜBER DIE BACTERICIDE UND VIRULENZVERMINDERnde WIRKUNG VON SPEICHEL AUF PNEUMOKOKKEN [On the bactericidal and virulence-reducing action of saliva on pneumococci]. *Zeitschr. f. Hyg. u. Infektionskrankh.*, 118 (1): 1-16.

The antibacterial activity of fresh, of filtered (Seitz), and of inactivated (heated at 55-56° for 45 min.) saliva samples of five subjects was tested against pneumococcal Types I and II. Studies were made at room and body temperatures; method is described in detail. Bouillion-saliva cultures served as controls.

At room temperature, fresh saliva exerted the greatest antibacterial action, destroying all pneumococci in 4-6 days. Filtered saliva was effective in 6-7, and inactivated saliva in 6-10 days. When compared with the controls, it was seen that both inactivated and filtered salivas alone served as a better nutrient than did bouillion-saliva cultures, the pneumococci only persisting for 3 days on the latter. No difference in the susceptibility of the two organismal types was observed.

At body temperature (37°), the effects of the three salivas were augmented. Fresh saliva was bactericidal within 12-18 hours; filtered saliva, within 1-2 days; and inactivated saliva, within 1-5 days. The controls supported the pneumococci for 5-6 days.

In an effort to reproduce oral conditions, in which bacteria are not constantly in contact with the same saliva but are subjected to continuous saliva production, *in vitro* tests were made, subjecting pneumococci to daily changes of freshly-secreted saliva (at room temperature). Fresh saliva was effective within 1 day; filtered saliva, within 2-7; and inactivated saliva, within 3-6. The controls supported pneumococcal growth for 4-6 days. As compared with previous studies at room temperature, the daily introduction of fresh saliva greatly enhanced the bactericidal effects.

The serological type-specificity of both types of pneumococci was unaffected by exposure to saliva over "longer" periods of time.

Mouse virulence tests indicated the saliva-treated pneumococci quickly lose their virulence for white mice. It is concluded that saliva has the ability to transform virulent pneumococci into avirulent forms.

Petrova, V. V., 1938. ÄNDERUNGEN DER BIOCHEMISCHEN KONSTANTEN (RESTUND GESAMT-N, HARNSTOFF) DES SPEICHELs BEI NEPHRITIS [Changes in the

biochemical constant values (residue and total nitrogen, urate) of the saliva in cases of nephritis]. *Bull. Biol. Med. exper. URSS*, 5 (3): 215-217.

The nitrogen content of saliva was repeatedly analyzed in 11 cases of typical nephritis. The saliva was collected from the submaxillary and sublingual glands through Krasnogorskii's cap; 20 gm. of sugar-glazed cranberries, eaten in 3 min., served as salivary stimulant. Residual and total nitrogen were determined in the saliva by Bang's method, slightly modified. The nitrogen content of the blood was measured simultaneously.

Tabulated results show an increase of residual and total nitrogen content in saliva and an increase in salivary urate [where urate was present]. In acute cases the residual nitrogen increases double to three-fold its normal value (up to 167 mg.%); in chronic cases it remains at a higher level during the whole duration of the disease. Thus, the augmentation of nitrogen in saliva corresponds to its augmentation in the blood.

In cases of favorable outcome of the disease, an increased salivary secretion was observed with relatively augmented residual nitrogen content.

The author believes that the determination of residual nitrogen in the saliva can serve as a method for early diagnosis of nephritis.

Petrova, V. V., and N. R. Shastin, 1941. K VOPROSU O KACHESTVENNOM SOSTAVE SLIŬNY U DETEI [On the qualitative composition of the saliva in children]. *Fiziol. Zhurn.*, 30 (4): 484-488.

Study was made of the general and residual nitrogen content in parotid and submaxillary saliva and of its alkaline reserve in children. Krasnogorskii's method was used: the saliva was collected on an empty stomach directly from the parotid or the submaxillary gland by means of a silver cap attached over the opening of the ducts. 30 cc. of 0.5% citric acid, 20 g. of sugar-coated cranberry (*Oxycoccus palustris*), bread, turnips, or chocolate were used as stimulants. The stimulant was eaten in 3 min. with mastication of the same side as the cap. The general and residual nitrogen were calculated according to a slightly modified Kjeldahl method, the alkaline reserve by the van Slyke, the carbamide by the Hensch-Aldrich method. An average of 5 measurements were made for each component.

Strong food stimuli (cranberry, chocolate) elicit a more concentrated saliva than weak (citric acid). By intensive activity of the gland the solid residue of the saliva is increased.

The general and residual nitrogen content was found to depend primarily on the amount of saliva secreted in response to various stimuli. The greatest amount of general nitrogen was elicited through feeding of cranberry, 100.75 to 134 mg. per 100 cc., and the smallest through stimulation with citric acid, 61.58 to 104 mg. per 100. The same relation existed for residual nitrogen: 35.2 to 61.9 mg./100 for cranberries, and 17 to 57.6 mg./100 for citric acid. Carbamide is elicited in most cases after stimulation with cranberries [average 31.3 mg./100], not with citric acid. Cranberries also elicit more saliva than citric acid. The content of residual nitrogen in the parotid saliva after cranberry stimulation is greater than that of the blood at the same time.

The alkaline reserve in parotid saliva after stimulation with cranberries is: 84.4 to 110.0 per 100 CO₂; for chocolate, 72.9 to 110.9; for bread, 58.5 to 82.5; for turnips, 41.2 to 46.1; and for citric acid, 29.6 to 48.1.

Spontaneous parotid saliva has a very low alkaline reserve (9.9) and a relatively high content of general and residual nitrogen.

The submaxillary saliva is less concentrated than the parotid in children. The general and residual nitrogen content, as well as the alkaline reserve, are approximately one-half that of the parotid.

The method of collecting the saliva, either mixed or parotid, the various stimulants used, and the duration of collection influence the composition of the saliva.

Petrovich, A. A., 1929. ZAKON "VSE ILI NICHEGO" V RABOTE SLIUNNYKH ZHELEZ U CHELOVEKA [The "everything or nothing" law in the activity of the salivary gland in man]. Zhur. eksper. Biol. Med., Moskva, 12 (32): 208-210.

Application of the "everything or nothing" rule to the salivary gland was studied in a 9-year old child with three fistulas in the right parotid, resulting from parotitis 4 years previously; the largest fistula was of pin-head size. Secretion flowed from any one or more of them either spontaneously before meals, or in response to food, to oral rinsing with various dilutions of hydrochloric acid, or to subcutaneous injections of pilocarpine (0.5 or 0.75 cc. at 1%), or 0.5 cc. of adrenalin at 1:1000. The tests showed that not all the parts of the parotid gland work together simultaneously. Only during the strongest stimulation (eating, subcutaneous injection of 0.75 cc. of 1% pilocarpine) did all three parts work together. Whether the observed gland was functioning normally is questioned.

Petryaev, E. D., 1948. ANTIGEN SUBSTANCES IN THE SALIVA OF DYSENTERY PATIENTS. Amer. Review Soviet Med., 5 (2): 140-142.

Seventy-three tests, performed in 20 individuals, plus two sets of control tests showed the presence of a specific antigen in the saliva of dysentery patients (Flexner type, or without bacteriological confirmation). Salivary samples were collected after careful oral rinsing, which stimulated salivation. The presence of a specific antigen in the saliva was demonstrated by the ring precipitation method, the titer of the precipitating serum (Hiss-Flexner, of the Moscow City Bacteriological Institute) being 1:400,000 when tested against the "whole antigen". The saliva filtrate was distributed in 0.2 to 0.3 cc. samples, underlaid with the precipitating serum. A positive reaction was indicated by the formation of a white ring.

Positive precipitation reactions of the saliva were observed on the first and second days following the onset of the disease; on the third to fifth day the reaction reached its peak. With the disappearance of clinical symptoms the reaction became less pronounced, and with the passing of formed stool (10 to 12th day) the test was regarded as doubtful. The incidence of precipitinogen in the saliva depended on the condition of the patient at the time of observation. During convalescence the test for precipitinogen yielded a consistently negative result; one case which

gave a weak precipitation reaction had a relapse 6 days following discharge from the hospital.

Cultures of test saliva did not show the presence of dysentery bacilli. There was no positive precipitation reaction with the hapten derived by the White method from the washings of this growth.

Two rabbits were immunized during 5 days, with 1, 2, or 3 cc. of saliva of the patients collected on the fourth and sixth day of the disease; a third rabbit, serving as control, was injected with the saliva of a healthy individual. Agglutination tests with these serums, performed within 8 days following the last injection, with homologous strains and stock cultures of Flexner bacilli No. 1380 and 1367, produced agglutination up to 1:320, while the control produced only 1:10.

These experiments show that the saliva of dysentery patients contains a specific antigen, the presence of which can be determined at the onset of the disease. The simplicity of the precipitation method and its positive results in the first days of the disease gives to these tests both a theoretical and practical importance which may be of diagnostic significance.

Pfeiffer, Carl C., and Helen L. Holland, 1945. SALIVARY SULFONAMIDE LEVELS AFTER CHEWING PARAFFIN AND CHICLE VEHICLES. U. S. naval med. Bull., 44 (4): 695-699.

The effects of chewing paraffin or chicle wafers containing either sulfadiazine (325 mg.) plus aspirin (190 mg.), or sulfathiazole (250 mg.), on salivary sulfonamide levels were studied. In 4 experiments (at least 9 persons each), the subjects were given the test wafers to chew at normal chewing rates, first letting the wafer rest in the mouth for 2-3 minutes to prevent initial fragmentation. Saliva samples were collected at 0-5, 5-10, 10-15, 25-30, 55-60, and 85-90 minutes and analyzed for sulfonamide content (method fully described). Four tables of data are given.

Regardless of which vehicle was used, sulfathiazole attained a high salivary level quickly and maintained it for the 90-minute period; sulfadiazine values did not attain a high level until the end of the 90-minute period. Chicle was the more favorable vehicle in that it tended to fragment only after 60-90 minutes of chewing (paraffin, within the first 15 minutes).

Piasecka-Zeyland, E., and J. Zeyland, 1937. ON THE INHIBITORY EFFECT OF HUMAN SALIVA ON THE GROWTH OF TUBERCLE BACILLI. Tubercle, 19 (1): 24-27.

Six experiments were made testing the effect of human saliva on tubercle bacilli. One cc. of saliva (or saline, in controls) was mixed with 100 mg. tubercle bacillus culture (3-week-old bovine strain 1714), thoroughly shaken, and incubated at 37°C. until the next day, when an equal quantity of sulphuric acid (20%) was added, and let stand for 20 minutes. Ten tubes of Petragnani's medium were each inoculated with the mixture (2.5 milligrams of bacilli in 0.05 [cc? fluid]). Observations made every week for 8 weeks indicated that in certain cases human saliva inhibits growth of tubercle bacilli. This inhibition is contingent upon individual variations and, to some extent, on some "unknown factors".

Pickerill, H. P., 1913. NOTE ON THE QUANTITATIVE DIFFERENCE BETWEEN PAROTID AND SUBMAXILLARY SECRETION. *Brit. dent. Jour.*, 34 (22): 1213-1215.

A discussion is presented on the small secretion of the parotid gland in comparison with its size and structure and on the precise mode of normal stimulation of the gland.

Pickerill, H. P., 1915. THE ETIOLOGY OF DENTAL CARIES. *Brit. dent. Jour.*, 36 (7): 313-323; (8): 361-385.

The etiology of dental caries is discussed with respect to its history, geographical distribution, food habits of individual groups, the influence of occupation, heredity, and the pathology of the process. The 2 chief factors cited as possible etiologic agents are the carbohydrates of the diet and the microorganisms of the mouth. The 2 chief defensive factors are the resistance of the enamel surface and the protective action of the salivary secretion.

Pickerill, H. P., 1917. THE EFFECTS OF ORGANIC ACIDS UPON THE TEETH. *Brit. dent. Jour.*, 38 (13): 553-557.

The effect of organic acids on the teeth is discussed. The acids caused an increase in salivary secretion and are therefore considered to be of value in preventing dental decay.

Pickerill, H. P., 1924. SALIVARY SECRETION AND ACID DENTIFRICES. *Brit. dent. Jour.*, 45 (20): 1394-1401.

A study was made of the effects of acid and alkaline substances on the alkalinity and rate of the salivary secretion. Acid dentifrices are thought to stimulate the production of more of the alkaline saliva which is then used to neutralize lactic acid and prevent caries. The alkaline dentifrices are said to have a depressant action on the salivary flow. Salivary analyses of 50 caries-immune Maori children were compared with analyses of 50 susceptible European children and the total alkalinity per minute was six times greater in the Maori children, while the ptyalin index was more than twice as great. The alkalinity and amount of flow of saliva are regarded as the most important defensive mechanisms of the saliva.

Pierce, F. Richard, and Magnus I. Gregerson, 1937. CHANGES IN THE SUBMAXILLARY SECRETORY RESPONSE TO PILOCARPINE AFTER SECTION OF THE CHORDA TYMPANI. *Amer. Jour. Physiol.*, 120 (2): 246-256.

The salivary response to pilocarpine was investigated in five dogs before and after section of the chorda tympani. Bilateral submaxillary fistulae were established and the normal response of the submaxillary gland to pilocarpine stimulation was determined. One gland was deprived of its parasympathetic nerve supply; the other was used as a control. No anaesthesia was used. The dogs were starved for 24 hrs. prior to test, then injections of 2 mg./100 cc. of pilocarpine in saline solution were given at a constant rate for 20 minutes, and the rate of secretion was observed for 30 minutes.

Tests showed no essential change in salivation after denervation of the gland for a period up to 48 hours after severing the nerve. On the 6th day after denervation the gland began to

secrete earlier upon pilocarpine injection and delivered more saliva than the normal gland. The change took two to three weeks for full development. The increased sensitivity of the submaxillary gland to pilocarpine was found to be undiminished 6 months and 1 year after denervation.

Pigman, Ward, and A. Jane Reid, 1952. THE ORGANIC COMPOUNDS AND ENZYMES OF HUMAN SALIVA. *Jour. Amer. dental Assoc.*, 45 (3): 325-338.

An extensive review of the literature on the organic compounds (i.e., proteins, carbohydrates, amino acids, blood-group substances, vitamins, enzymes, hormones, etc.) of human saliva. 103 refs.

Pigman, Ward, 1954. IN VITRO STUDIES OF DENTAL DECAY. *Science*, 120 (3124): 810.

Pooled samples of human saliva, into which extracted human teeth were placed, caused the teeth to become rapidly covered with a mass of microorganisms. The teeth were prepared for experimentation by washing for several months in an "artificial saliva" bacteriological medium.

Pigman, Ward, 1957. SOME RECENT DEVELOPMENTS IN THE COMPOSITION AND PHYSIOLOGY OF HUMAN SALIVA. *Jour. Amer. dent. Assoc.*, 54 (4): 469-472.

This paper discusses the appliances and techniques used, and the results obtained in recent investigations on the composition and physiology of human saliva. Thirty-eight references dealing with the rate of flow of secretions, methods of collecting, techniques of stimulating and controlling secretion, as well as the composition of saliva and contributions of the major salivary glands, are cited. Summary discussions are given on the principal components of salivas, such as protein fractions, enzymes (and their origins), amino acid composition, the nature of free amino acids and vitamins, and to the nature and concentration of carbohydrates in relation to oral clearance studies and to stimulatory effects on oral bacteria.

Pigman, W., and W. L. Hawkins, 1958. THE REDUCING POWER OF HUMAN SALIVARY SECRETIONS. *Jour. dent. Res.*, 37 (1): 30.

The reducing power of whole human salivas and of parotid, submaxillary, sublingual, and mucosal secretions have been measured by the Folin-Malmros method and reported as apparent glucose. Generally, the parotid and submaxillary secretions have less reducing power than the sublingual and mucosal secretions. The only noticeable effect of stimulation was observed for the parotid gland, which showed a decreased reducing power upon stimulation. In agreement with the earlier results of Lundquist, no evidence was found for the presence of any free sugars, although several different methods were tried. The various methods indicate a maximum possible concentration of glucose of about 0.5 mg. per 100 cc. The reducing substances of the salivary secretions seem to be a heterogeneous mixture of various carbohydrates, proteins, glyco-proteins, and some small molecular weight materials. (Author's abstract)

Pigman, W., and W. L. Hawkins, 1958a. THE REDUCING POWER OF HUMAN SALIVA AND ITS COMPONENT SECRETIONS. *Jour. dent. Res.*, 37 (4): 688-696.

The reducing power of whole salivas and of parotid, submaxillary, sublingual, and mucosal secretions has been measured by the Folin-Malmros method and reported as apparent glucose. Generally, the parotid and submaxillary secretions have less reducing power than the sublingual and mucosal secretions. The only noticeable effect of stimulation was observed for the parotid gland, which showed a decreased reducing power upon stimulation. In agreement with the earlier results of Lundquist, no evidence was found for the presence of any free sugars, although several different methods were tried. The various methods indicate a probable maximum concentration of about 0.5 mg. per 100 cc. The reducing substances of the salivary secretions seem to be a heterogeneous mixture of various carbohydrates, proteins, glycoproteins and some small molecular weight materials. The sensitivity of a number of spray reagents useful for the detection of sugars and hexosamines on paper chromatograms is reported. (Author's summary)

Plagge, James C., 1938. THE VITAL IMPORTANCE OF SALIVARY GLANDS TO NEWBORN RATS. *Amer. Jour. Physiol.*, 124 (3): 612-619.

The effects of the removal of certain salivary glands, closure of salivary ducts, and various combinations of these on the growth and survival of young rats were studied. It was found that:

"1. Newborn rats deprived of the two submaxillary and two major sublingual glands invariably die within 5 days.

"2. Any one member of the pair of 4 glands suffices for continued life and growth.

"3. Ligation of the salivary ducts likewise results in death of the young, and histological study reveals rapid pressure degeneration of the glands.

"4. Death from salivary gland removal is due to inanition since the young, though making attempts to suckle, fail to swallow milk.

"5. Operated young force-fed with cow's milk survive and grow.

"6. It appears that the disturbance is associated with some mechanical factor in the feeding process rather than with some chemical phase of the physiology of digestion." (Author's conclusions.)

Podkopaev, N. A., 1925. K FIZIOLOGII VOSSTANOVITEL'NYKH PROTSESSOV. PROTSESSY VOSSTANOVLENIYA GL. SUBMAXILLARIS SOBAKI [Addition to the physiology of restoration. The processes of restoration in the submaxillary gland]. *Fiziol. Zhurn. SSSR*, 8 (3-4): 114-115.

A series of experiments were made in a normal dog with chronic experimental submaxillary fistula to study the processes of restoration in this gland. The depletion of the specific glandular product, mucin, was obtained by repeated feeding of crushed rusks. The 2nd, 10th, 20th and 30th salivary samples were examined for percentage of water, organic matter, and ash content.

Results confirmed earlier findings of the depletion of organic substances in the saliva of working glands: after 30 feedings, one every 3 min., a minimum level of 50% mucin was reached as compared to the normal amount at the start of the experience. A rest period of varied length

was then allowed to the glands, during which all possible food reflexes were excluded and only water given. Evidence was obtained that the process of restoration in the submaxillary glands is very slow; the level at which the experiments started is reached only after 36 to 40 hours of complete rest.

To determine the action of temporary starvation on the restoration process and to evaluate the physiological conditions which influence them, one or the other of two nourishing fluids was introduced into the animal's stomach through a tube 15 min. after the last experimental feeding; after this, the animal was left to rest for the same period of time. The caloric contents of these fluids were more than sufficient for the animal's need; they differed only in the nature of their albumin: vegetal in one, milk albumin in the other. In spite of the tube feeding, the restoration of mucin content in the submaxillary glands lasted as long as without tube feeding, i.e., mucin reached its normal level 36 to 40 hours after depletion.

Podkopaev, N. A., 1936. OMEKHAIZME ZAPAZDYVANIYA BEZUSLOVNOGO SLIUNNOGO REFLEKSA [On the mechanism of delay in the unconditioned salivary reflex]. *Arkh. biol. Nauk, Leningrad*, 42 (1-2): 27-39.

A study was made of retarded unconditioned salivation in 2 dogs exhibiting a delayed response between conditioned and unconditioned salivation at the moment of feeding. Attempts to establish a conditioned salivation to other stimuli flowed normally after the usual 2 to 3-second lag period, and increased with application of isolated 5-second stimulations. Salivation ceased abruptly to resume after 5-15 seconds when 25 gm. portions of the rusk-powder food were presented on the 21st second and immediately eaten; the delay in the unconditioned response increased toward the end of the experimental day. A distinct drop in this delay was noted after feeding without application of conditioned stimuli, but increased to 20-25 seconds at the end of the day after extensive feeding. Administration of caffeine augmented the delay in unconditioned salivation; oral administration of 1.5 gm. of sodium bromide during 3 days eliminated the delay in response. Cortical effects of the experimental technique are discussed.

Podkopaev, N. A., 1941. DAL'NEISHIE MATERIALY K VOPROSU O VZAIMOOTNOSHENII VELICHIN USLOVNOGO I BEZUSLOVNOGO PISHCHEVYKH REFLEKSOV [Further data on the relationship between conditioned and unconditioned food reflexes]. *Fiziol. Zhurn. SSSR*, 30 (1): 21-25.

The relationship between conditioned and unconditioned salivary response was studied in 3 dogs of a strong nervous type. The animals were fed normally without specific conditional stimulation prior to the usual experiments. Strong or weak conditioned stimuli were then administered before further unconditioned stimulation and were continued with it from 0 to 45 seconds. Conditioned salivation was registered every 5 seconds; unconditioned salivation was determined only for the first and second 30-minute periods of eating. Test results show a consistent increase in the unconditioned response with increase in strength of the conditioned stimulus. The unconditioned

response in one dog previously administered a weak conditioned stimulus, which evoked a 0-10 salivary unit response, was less than its normal unconditioned response; an unconditioned response, after a stronger conditioned stimulation which evoked 10-20 units of saliva, equaled the normal unconditioned response; the unconditioned response, after administration of a strong conditioned stimulus eliciting a 20-40 unit response, considerably exceeded the normal unconditioned. Prolongation of conditioned stimulation in another dog, simultaneously with the unconditioned, produced a sharp drop from normal in the unconditioned response. These relationships were apparent only after several weeks of experimentations when the conditioned reflex had been firmly established; their distinctness showed individual variation and were seen only in the salivary sample collected during a first 30-second period of eating after conditioned stimulation. The influence of conditioned stimulation is not reflected in the saliva from the second 30-second period.

Polezhaeva, L. V., 1938. BAKTERIZIDNYE I TOKSICHESKIE SVOISIVA SLIŬNY [Bactericidal and toxic properties of saliva]. Stomatologiia, Moscow, 4: 44-55.

Human saliva, collected 2 hours after breakfast, was tested for bactericidal and toxic activity; tests showed the saliva to fluctuate around pH 7.0. A yellow staphylococcus, isolated from pus, was used as the test organism to investigate the bactericidal action of either fresh, heated, or filtered saliva, standing saliva, saliva treated with various antiseptics, or saliva collected aseptically from the parotid duct. In the bactericidal tests one drop of a bacterial emulsion (500 million organisms) was added to 3 cc. of saliva and incubated at 37°C for 1, 3, and 24 hours before seeding sugar-agar plates. Colony counts were made after 24-48 hour incubation at 37°C. Physiological solution replaced saliva in a similar control series. Nine of 50 tests of fresh saliva showed a decreased count after 1 hour of contact with saliva; 33 showed considerable growth inhibition after 3 hours of contact; 33 showed complete absence of the staphylococcus after 24 hours of contact, the other normal salivary flora being still present. Bactericidal tests of saliva standing from 1 to 7 days showed low and steadily decreasing activity; salivary sediment showed much greater activity than the filtrate. A slight delay in growth was noted in 20 of 32 tests after 1 hour of contact; 7 of 32 tests showed considerable inhibition after 3 hours of contact, 10 tests showed slight growth retardation; 3 tests showed absence of growth, and 9 tests retarded growth after 24 hours of contact. Thirty-two tests of the filtrate of fresh saliva, filtered through ash-free filter paper, showed decreased growth in 1 case after 3 hours contact, and in 6 cases after 24 hours contact. Twenty tests of the residue showed inhibition in 16 cases after 1 hour contact, 18 cases after 3 hours contact (complete inhibition in 2 others), and 11 after 24 hours contact (decrease in size in 1 other case, complete inhibition in 6 others). Fresh saliva boiled for one minute showed no antibacterial activity even after 24 hours contact. Fourteen tests of saliva heated to 30°, 40°, 50°, and 60°C for 20 minutes showed heating to 50° - 60° destroys antibacterial activity;

heating to 30° - 40°C does not; retarded growth was observed after 1 to 3 hours contact, colonies being barely visible after 24 hours contact. Addition of a drop of various antiseptics (phenol, formalin, acetic acid, sodium hydroxide, thymol in very weak dilutions or in dilutions inhibiting bacterial growth) to standing saliva did not prolong the antibacterial activity of the saliva in 360 tests. One hundred tests of fresh parotid saliva, collected by means of a Lashley cap, showed no inhibiting power after 1 hour of contact; delayed growth was noted in 4 cases after 3 hours contact; complete sterility in 21 cases and strong inhibition in 79 cases was noted after 24 hours contact. Control tests in these experiments showed abundant growth of the staphylococcus. Growth inhibition is attributed to antibacterial activity of the saliva or to the possible presence of an inhibine, and not to its poor culture-medium properties or to antagonism between its saprophytes and pathogenic flora.

To study the importance of saliva in the healing of oral lesions white mice, rabbits and guinea pigs were administered 1 cc. subcutaneous injections of either fresh mixed-saliva, salivary filtrate, salivary residue, boiled saliva, saliva heated at 50°C for 25 minutes, aseptic parotid saliva or saliva with 0.6% thymol added. Tabulated results in tests using mice show 71.0% of deaths after injection of fresh mixed saliva, 29% after injection of salivary filtrate, 80% after the mucous residue, 25% after heated saliva, 50% after saliva plus thymol used immediately, none after saliva plus thymol after standing for 24 hours, and none after pure parotid saliva. Each test that included a certain sterilization of the saliva, decreased the incidence of death. The deaths occurred on the second day after injection, seldom on the third or fourth. Bacteriological examination of the animals' blood and organs showed the presence of the usual oral flora: diplococci, micrococci, and gram-positive rods. Three of 13 mice died after injection of a pure culture of staphylococcus; all of 11 mice died after injection of this culture mixed with saliva, cultures from their blood showing growth of pneumococcus and micrococci but no staphylococcus. Parallel experiments in rabbits and guinea pigs showed local reaction but no general sepsis. In 5 rabbits subcutaneous injections of 0.1 to 0.2 cc. of fresh saliva produced an abscess, developing on the 3rd to 4th day after the injection and containing diplococci and gram-positive rods. Repeated subcutaneous injections of saliva in 4 animals produced septicemia with large subcutaneous pus accumulation, small pus foci in the inner organs and, in some cases, mucosal exudates. Cultures of the infected organs showed the usual oral flora as previously noted in the mice. Intra-peritoneal injection of 0.2 cc. of salivary filtration residue produced death on the sixth day from pneumonia and pleuresy; similar injection of aseptic parotid saliva produced no inflammation in 7 tests. Subcutaneous injection of the pure parotid saliva, mixed with staphylococcus culture, into the rabbit produced no or only insignificant abscesses in 6 tests. Saliva thus inhibits growth of the staphylococcus, both in vivo and in vitro, but does not inhibit diplococci or other normal oral organisms. The pathogenicity of saliva is attributed to the pathogens contained in mixed non-sterile saliva. The experiments do not indicate

the rapid healing of oral lesions to be attributed to the bactericidal property of saliva but to a combination of causes. The reported toxicity of saliva is not confirmed.

Poliakova, , and students, 1927. OPTY SLIŮNY U BEREMENNYKH ZHENSHCHIN [Salivary tests in pregnant women]. Kazan. Med. Zhur., 23 (3): 317-320.

The concentration of H-ions and the presence of thiocyanates in saliva were studied in 92 women, 71 of whom were pregnant, and 11 others shortly after childbirth. The saliva, stimulated when necessary by the respiration of ether vapors, was collected 1 to 1.5 hours after breakfast. The pH was determined by Michaelis', the thiocyanate content by Maisell's [?] colorimetric method.

Results showed that the saliva of pregnant women is not more acid than normal. In the first half period of pregnancy, however, the pH values were slightly lower, not exceeding 7.5, in the second half, 50% of the pregnant women had a pH between 7.4 and 6.8.

The presence of thiocyanate is by no means constant: it could be detected only in 43 cases out of the 92. In 20 determinations made its content was found to be below 0.00005/cc. of saliva. No relation could be established between the pH values and the thiocyanate content. It was observed, however, that in women with healthy teeth and in those who took proper sanitary care of the mouth, the presence of thiocyanate was found more often than in the others.

Pollaci, G., and S. Ceraulo, 1909. DAS AGGLUTINATIONSVERMÖGEN EINIGER KÖRPERFLÜSSIGKEITEN BEIM MEDITERRANFIEBER [The agglutinating properties of several body fluids during Malta fever]. Centralbl. f. Bakteriologie, (1) 52 (2): 268-275.

Agglutination reactions in healthy persons and Malta fever patients were studied, using several body fluids, among them saliva.

In testing the agglutinating action of saliva of 50 healthy persons and 100 sick persons (other than Malta fever patients), examinations were made when the patients' stomachs were empty and full, and while they were chewing. In every case, mixed, undiluted, filtered saliva caused no agglutination of *Micrococcus melitensis*.

The saliva of two individuals, one healthy person and the other having mitral stenosis and insufficiency, showed a very slight agglutinating effect which was destructible through dilution.

Twenty Malta fever patients showed positive and complete agglutination by saliva (undiluted and in dilutions from 1:10 to 1:50).

Saliva tested for group agglutination on the typhoid coli group, *Shigella dysenteriae*, 2 species of *Streptococcus*, *Staphylococcus albus* and *S. aureus*, and 1 tetragenous species, gave negative results.

The constancy of agglutination reaction in Malta fever patients established the reaction to be a specific one.

Comparisons of agglutination by saliva with similar reactions in urine and serum were made.

Polonovski, M. and P. Combemale, 1923. ACTION DE LA GÉNÉSÉRINE SUR LES SÉCRÉTIONS SALIVAIRES ET PANCRÉATIQUES [Action of geneserine on salivary and pancreatic secretions]. Compt. rend. de la Soc. de Biol. (Paris), 88 (12): 881-883.

Injections of geneserine were made into the saphenous vein of 17 dogs to study stimulatory effects of the drug. A marked acceleration of secretion occurred 2 to 5 minutes after injection of a 1.0 to 0.1% dose (about 1 mg. per Kg. of body weight) and persisted for 20 minutes. Injection of atropine caused this salivation to stop. Geneserine, less toxic than eserine, was considered to act in the same way as eserine.

Ponirovskii, N. G., (Tchernavskii, Berenstein, Lurje and Aisenmann), 1925. O VLIĖNIĖ VYTĖAZHEK IZ SHCHETOVIDNOI ZHELEZY NA SEKRETSIIŮ SLIŮNY. BESEDA. [On the influence of thyroid extracts on salivary secretions. Short report]. Fiziol. Zhurn. SSSR, 8 (3-4): 108-109.

Three dogs with chronic experimental fistulae of all three salivary glands were used to determine the influence of thyroxin (dry product of the Organotherapeutical Institute in Kharkov) or of fresh thyroid extracts on salivary secretion.

Subcutaneous injections of thyroxin or fresh thyroid extracts do not change the salivary secretion elicited by the eating of rusks, by subcutaneous pilocarpine, or by intravenous suprarenin injections.

Intravenous injections of 1.5 to 2 cc. of a 5% aqueous thyroxin solution always increase the salivation elicited by crushed rusks or by intravenous suprarenin injections, but have practically no effect on pilocarpine salivation. This thyroxin action lasts only 10 to 15 min. after the injection; it appears much more clearly in the submaxillary than in the parotid gland.

Removal of the thyroid gland in the dog did not influence the secretion from the parotid gland.

Ponirovskii, N. G., B. E. Aizenman, Askalonov, Berenstein, Raiskii and Konovalov, 1925a. VLIĖNIE UDALENIIĖ PARASHCHITOVIDNYKH ZHELEZ NA SEKRETSIIŮ SLIŮNY. BESEDA [Influence of the removal of the parathyroid glands on salivary secretion. Short report]. Fiziol. Zhurn. SSSR, 8 (3-4): 110-111.

Salivary secretion was studied in three dogs with experimental fistulae of the parotid and submaxillary glands, whose parathyroid glands had been either completely or partially removed.

Complete removal of the parathyroid glands in one dog produced, along with developing tetany, a 150 percent increase in salivary secretion after pilocarpine injections, with the feeding of rusks. This effect, however, was noticed only as long as the animal would eat and not become emaciated; during further development of tetany and under conditions of emaciation, the quantity of saliva secreted was below normal in response to pilocarpine and to food. After the injection of suprarenin, the secretion was greatly reduced and later disappeared completely. (This drug now manifested a strongly toxic action on the organism, even for doses which were unnoticed before the operation.) The question arises, whether the decrease in secretion was due to a spasm of the salivary gland vessels.

A partial or extensive removal of the parathyroid glands in the two other dogs (the thyroid remaining intact) gave results comparable to those observed after complete removal.

Ponirovskii, N. G., and N. IA. GonetskaiĖ, 1939. VPLIV NEIROTROPNYKH RECHOVIN NA SEKRETORNI (SLIŮNOVIDDEIL'NY) NERVI PRI EKSPERIMENTAL'NII

SENSIBILIZATSII [The action of neurotropic substances on secretory (salivary) nerves after experimental sensitization]. Eksper. Med. Kharkov, 1939 (4): 1-4.

Study was made of the effects of pilocarpine and of adrenalin on canine salivation during serum sensitization in 8 dogs having permanent parotid and submaxillary fistulas. Normal salivation was determined in 4 dogs in response to adrenalin and pilocarpine, to adrenalin alone in 2 dogs, and to pilocarpine alone in 2 other dogs. The normal rate of salivation in response to rusk-powder was determined in a one-hour interval between injection of these drugs. A series of 3-horse-serum injections were given the dogs: a 0.5 cc./kg. weight dose administered subcutaneously, 3 days later the same amount given intravenously, and then 21 to 24 days later the same or half the dose given intravenously. Serum, injected a half-hour after the start of pilocarpine salivation, produces an increase in salivation during the second and third half-hour periods of secretion. After subsequent injections of adrenalin and pilocarpine, an intravenous serum injection administered a half-hour after pilocarpine salivation has started, produces a pronounced decrease in secretion during the next hour. After injection of pilocarpine alone, the second injection of serum keeps the secretion rate at a high level within normal limits during the next hour. The third (discharging) serum injection, after producing a short rise in salivary secretion, completely or almost completely stops salivation. Results obtained after adrenalin will be published in a separate article. [From author's summary]

Popel'skiĭ, L. B., 1901. O TSELESOOBRAZOSTI V RABOTE PISHCHEVARITEL'NYKH ZHELEZ [On the purposefulness in the activity of the salivary glands]. Vrach (5): 1539-1540.

Experiments in the dog show that oral stimulation effected by an acid solution, dry foods, or fine sand, initiates both salivary and pancreatic secretion by affecting nerve endings in the oral mucosa. A coarse mechanical stimulant like gravel does not reach the nerve endings and has no effect on salivation.

Popova-Milashevskaiâ, V. A., 1950. pH I KHLORIDY SLIŬNY U BOL'NYKH KARIESOM [The pH and chlorides in the saliva of (dental) patients with caries]. Stomatologiiâ, 2: 14-16.

The pH values and chloride content of saliva were studied in 40 dental caries patients varying from 13 to 54 years of age. The saliva was collected before breakfast and its pH determined electrometrically with the following results:

The pH values varied from 6.65 to 7.6, with an average of 7.13. The greatest acidity was noted in cases of pulpar gangrene (6.65 to 7.24), nearly neutral pH in caries (6.68 to 7.36), the greatest alkalinity in cases of pulpitis and periodontitis (7.3 to 7.6).

A relation of the salivary pH to age was observed: in 8 people up to 20 years of age it varied from 6.66 to 7.53; in 25 people of 20 to 40 years from 6.65 to 7.01; in 7 people over 40 from 7.08 to 7.36.

The chloride content was determined from the same salivary samples as the pH by Rode's method (adapted from Geier and Rotsche). It varied from

0.07 to 0.186 g./100, the average being 0.128 g./100. The lowest content was noted in cases of gangrene (0.07 to 0.117 g./100), the highest in pulpitis and periodontitis (0.117 to 0.196 g./100). In cases of dental caries the fluctuations are greater, from 0.07 to 0.186 g./100. It is noted that the salivary NaCl content in patients under 20 years of age, and in those over 40 was above 0.1 g./100.

The author concludes to a certain relation between the values of the pH and the NaCl content of saliva: above the age of 40 the saliva is more alkaline and richer in sodium chloride; the higher the alkalinity, the greater the NaCl content. This interdependence is especially noticeable in cases of pulpar gangrene.

Popow, N. A., and P. K. Denissow, 1930. ÜBER DEN EINFLUSS VON CALCIUM-UND NATRIUMIONEN AUF DIE ARBEIT DES SPEICHELZENTRUMS [The effect of calcium and sodium ions on the function of the salivary center]. Pflüger's Arch. ges. Physiol., 224 (1): 100-109.

The effect of various stimuli was investigated on the salivary center of the decerebrated dog, having cannulated submaxillary glands. Electrodes, excited for 1 second, at 5-second intervals, were placed on the peripheral side of the lingual nerve of the dog. Ten percent CaCl_2 and NaCl solutions were alternately injected into the femoral vein.

Results indicated that the section of the brain of the dog in front of the corpora quadrigemina activated the spontaneous function of the salivary center; however, the transversal section of the same part of the brain slowed down this process. The section of the left chorda tympani resulted in the decrease of the secretion of the submaxillary gland.

The electrical stimulation of the lingual nerve during spontaneous secretion first stimulated then inhibited the function of the salivary center. The introduction of CaCl_2 in the blood was followed either by stimulation, or by stimulation followed by inhibition, or by waves of stimulation and inhibition. The introduction of NaCl solution in the blood was followed by the inhibition of spontaneous secretion. Usually the introduction of calcium stimulated and that of sodium inhibited the function of the salivary center.

Popow, N. A., and A. A. Kudrjawzew, 1930a. ÜBER DEN EINFLUSS DER REAKTION DER ERREGER DER SPEICHELABSONDERUNG AUF DIE AKTIVE REAKTION DES SPEICHEL'S [The effect of the reaction of the stimulant of salivary secretion on the active reaction of the saliva]. Pflüger's Arch. ges. Physiol., 224 (1): 69-71.

First 5% hydrochloric acid, then 10% sodium carbonate or 0.25% sodium hydroxide used alternately, were administered orally to dogs having cannulated parotid glands. The dogs drank the liquid on an empty stomach at the same time every day. The hydrogen ion concentration of the samples of saliva thus stimulated were determined electrometrically.

Results indicated that the hydrogen ion concentration of the saliva collected after acid ingestion was lower than those of samples collected following alkali ingestion. The absolute pH of the saliva was 7.34 to 7.80, the average value being 7.56. Saliva secreted from the fistula had a higher pH value than the oral saliva.

Poth, Edgar J., 1933. A SIMPLIFIED TECHNIQUE FOR QUANTITATIVE COLLECTION OF SALIVARY SECRETIONS OF MAN. *Proc. Soc. exper. Biol. Med.*, 30 (7): 977-978.

A simple method for collecting salivary secretions, separately for each set of glands and simultaneously on both sides, is fully described. In general, pieces of weighed absorbent material (preferably the nasal tampons marketed by Johnson and Johnson) are applied to the various duct openings for a determined length of time, and reweighed to the nearest .05 g. The quantity of saliva collected is given by difference. Modifications of the method for the various glands are given.

Power, James Edward, 1906. THE RELATION OF SYSTEMIC DISEASES TO THE CONDITIONS OF THE ORAL CAVITY. *Jour. Amer. med. Assoc.*, 47 (5): 334-338.

A review discussing the antiseptic properties of saliva, the oral flora, transmission of disease by mouth, and the relation of oral diseases to swollen lymphatic glands, to inflammation of heart valves, and to pulmonary tuberculosis. No refs.

Pozerski, , 1900. ACTION DE QUELQUES FERMENTS SOLUBLES APRÈS REFOIDISSEMENT VERS -191 DEGRÈS AU MOYEN DE L'AIR LIQUIDE [Action of some soluble enzymes after chilling to -191°C. with liquid air]. *Compt. rend. de la Soc. de Biol. (Paris)*, 52 (26): 714-716.

Salivary diastase held at -191 C for 45 minutes was shown not to have lost its ability to convert starch to sugar upon rewarming.

Pozerski, E., 1927. SUR LA DIGESTION SALIVAIRE DE L'AMIDON CRU [On the salivary digestion of uncooked starch]. *Compt. rend. de la Soc. de Biol. (Paris)*, 96 (17): 1394-1396.

Microscopic examination of 1 g. of potato starch in 10 cc. of distilled water, ground for 5 minutes in a mortar, showed changes in the starch grains. A large number of the grains had lost their geometric form, they had tripled in volume, and their contents appeared granular.

A test was made of the effect of human saliva on uncooked potato starch, both ground and unground. 3 cc. of human saliva (1:25) in distilled water was added to the starch suspensions and incubated at 37°C. for 2 hours, then centrifuged.

The diluted saliva converted 2.4 g. per liter of ground starch but only 0.05 g. of unground starch; controls with distilled water alone showed a conversion of 0.05 g. per liter of either ground or unground starch. The author concludes that starch modified by grinding became digestible by salivary amylase.

Pozerski, E., 1927a. SUR LA DIGESTION SALIVAIRE DE L'AMIDON CRU [On the salivary digestion of uncooked starch]. *Compt. rend. de la Soc. de Biol. (Paris)*, 97 (35): 1592-1594.

Potato starch, suspended in distilled water, was treated with dilute human saliva for 2 hours at 38°C. Tests of the centrifuged and filtered liquid showed small amounts of reduced substance (0.25, 0.0, 0.35 g./liter). The experiment repeated after grinding the starch showed more reduced substances (3.8, 3.75, 2.24 g./liter).

In a second experiment unground starch, ground starch, supernatant fluid of centrifuged ground

starch, and washed precipitate of centrifuged ground starch were exposed to saliva action. Considerable reduced substances were found in the ground starch and supernatant fluid; only slight amounts were in the unground starch and precipitate.

Pratt, Ivan, and L. I. Eisenbradt, 1944. A COLORIMETRIC METHOD FOR THE DETERMINATION OF AMYLOLYSIS OF SALIVA. *Jour. dental Res.*, 23 (4): 267-272.

"1. A method of estimating the amylolytic activity of saliva is described. 2. Soluble starch was weighed accurately and dissolved in water so that 40 ml. contained 3.5 mg. of starch. The indicator was 0.05 N iodine. 3. A Klett-Summerson photoelectric colorimeter with KS-54 filter was used to determine color intensity of the starch-iodine mixture. 4. To 40 ml. of starch solution in a 20 mm. colorimeter cell was added 0.1 ml. of fresh saliva. The 2 solutions were mixed, the colorimeter was adjusted to zero and after 1 minute of digestion 0.025 ml. of iodine was added. After stirring, the amount of undigested starch was determined. This figure was subtracted from the original amount (3.5 mg.) to give the amount of starch actually digested. 5. This method measured amylolysis of saliva in terms of mgm. of starch digested under a standard set of conditions. 6. For 5 successive days fresh, unstimulated saliva of 6 individuals was tested for amylolytic activity at 9 and 11 a.m. and 1, 3, and 5 p.m. 7. Statistical analysis indicated that for the group the bi-hourly variations in amylolysis were not significant. 8. Variations among the 6 individuals in amylolytic activity of the saliva were statistically significant. 9. The technic needs additional refinement to take full advantage of the sensitivity of the photoelectric colorimeter." (Authors' summary and conclusions.)

Precht, Emanuel, 1928. ÜBER DEN EINFLUSS DER BEI ENZYMATISCHEN ARBEITEN GEBÄUCHLICHEN ANTI-SEPTIKA AUF DEN FERMENTPROZESS (NACH VERSUCHEN MIT SPEICHELDIASTASE) [The influence of antiseptics used in enzymatic studies on the fermentation process (according to experiments with salivary diastase)]. *Biol. Gen.*, 4 (1-2): 181-190.

The side-effects of bacterial action on salivary enzymes were tested. The inhibitory effects of several antiseptics (toluene, chloroform, chloral hydrate, sodium fluoride, and thymol) were investigated on the diastatic action of the saliva. Saliva was collected one hour after eating. Addition of 1 to 64 drops of toluene to a mixture consisting of 5 cc. of salivary solution (1:200 and 3 cc. 1% amylose, gradually reduced the diastatic activity, ending in a complete inhibition after addition of 64 drops in the period of 12 hours. Some diastatic inhibition was observed after addition of 10% chloroform (5 cc. in 1 liter water) to the salivary solution, while addition of about 60% of CHCl₃ entirely stopped diastatic activity. Salivary diastatic activity was considerably reduced by a 5% solution of chloral hydrate and completely inhibited by a 6% solution. Addition of 1% thymol caused certain delay in the amylolysis but no complete inhibition of the diastase activity was evident even after addition of 20 cc. of thymol-water.

Pribytkova, G. N., and S. I. Galperin, 1936. BLOCAGE DES FIBRES AFFÉRENTES DES GLANDES SALIVAIRE

PAR LA NOVOCAINE [Blocking of the afferent fibers of the salivary glands by novocaine]. Bull. Biol. Med. exper. URSS, 1 (4): 268.

The existence of centripetal impulses from the salivary glands to the subcortical layer was studied. Twenty-eight experiments of blocking were carried out on decerebrated cats and dogs. In over 10 experiments a minimal concentration of novocaine was used at a minimal dose necessary to determine an appreciable action on afferent fibers. The saliva was stimulated by small doses of pilocarpine and collected from both fistulated submaxillary glands.

The application of a cotton swab, dipped in a diluted solution of novocaine, under the chorda tympani regularly produces either an increase or a decrease of secretion in the corresponding gland. If the nerve is then washed of the novocaine with physiological solution, the salivary secretion of the corresponding gland returns to normal. The same results are obtained after resection of the lingual nerve. Subsequent stimulation of the peripheral end of the lingual nerve by a weak faradic current produces a sharp increase in salivary secretion, which proves that the afferent fibers of the chorda are intact.

The authors conclude that the extent of functional activity of the salivary glands is regulated by the cerebral cortex which receives impulses from all internal organs.

Prica, Milan, 1937. ÜBER DIE FRAGE DER ANTI-BAKTERIELLEN SPEICHELWIRKUNG AUF DIE KAPSELTRAGENDEN BAKTERIEN [On the question of antibacterial salivary action on encapsulated bacteria]. Zeitschr. f. Hyg. u. Infektionskrankh., 119 (3): 306-321.

The antibacterial action of variously treated salivas against a number of encapsulated microbes (designated as K-bacteria from "Kapseltragend") was studied at room and at body temperatures. Fresh, untreated saliva showed no inhibitory action against *Bact. rhinoscleromatis* [*Klebsiella r.*], *Bact. Friedländer* [*Klebsiella pneumoniae*] nor *Bact. ozanae* [*Klebsiella ozaenae*]. It did, however, effect constant, non-capsulated variants of all three microbes.

K-bacteria were markedly inhibited when seeded on 20-50% fresh saliva-agar plates.

Saliva was inactivated by filtration (Seitz) and heating; the addition of small quantities of fresh saliva quickly restored its antibacterial properties. Centrifugation, or paper-filtration of a mixture of fresh saliva and animal charcoal gradually completely inactivated fresh saliva; storage at room temperature or at 3°C. over "longer" periods of time weakened salivary activity. Both fresh saliva, and 30-50% saliva-agar plates, were actively antibacterial to K-bacteria through cellophane [cf. Weigman, 1940m].

A strong antagonism existed between the K-bacteria and the autochthonous salivary organisms.

The authors attribute the antibacterial capacity of saliva, at least that exhibited against K-bacteria, to microbial action. If the inhibines of Dold (cf. Dold, 1936m) are an actuality, then their action is dependent upon that of salivary bacteria.

Price, J. Waide, and Sholom Pearlman, 1947. METHOD FOR QUANTITATIVE ESTIMATION OF AMMONIA IN SALIVA. Jour. dental Res., 26 (6): 441.

"The method consists essentially of direct Nesslerization of a Somogyi zinc filtrate of saliva, and comparison of resulting color values with standard curve, using Klett-Summerson photoelectric colorimeter. Reagents required are (a) 10% $ZnSO_4 \cdot 7H_2O$ solution; (b) approximately 0.6 N NaOH adjusted so that 10 ml of zinc sulfate require 9.0 ± 0.2 ml of alkali to give permanent pink color to phenolphthalein; (c) Koch-McMeekin modification of Nessler's solution; (d) 2% gum ghatti solution; (e) standard solution containing 1 mg of ammonia-nitrogen per ml. Pipette 0.5 ml of zinc sulfate into each of 2 tubes, one for specimen and one for reagent blank. Add 8 ml of water to each specimen tube (9 ml to blank). Add 1 ml of saliva and, after mixing by inversion, allow to stand for 2 minutes. Add 0.5 ml of NaOH, mix thoroughly, and centrifuge at 2,000 r.p.m. for at least 5 minutes. Place 2 drops of gum ghatti in bottom of labelled colorimeter tubes. Remove from centrifuge and transfer 5 ml of supernatant fluid to labelled colorimeter tube. Add 1 ml of Nessler's solution, and whirl solutions immediately by striking bottom of tube with fingers. Read color 30 to 45 minutes later with Klett-Summerson photoelectric colorimeter, using a 54 green filter, with blank set at zero. The standard curve must be established by adding 0.5 ml and 1.0 ml of standard solution to 1 ml of several salivas, treating as outlined, and subtracting reading for saliva alone from readings obtained when standard was added. When these residual values are plotted against concentration of ammonia-nitrogen, the line obtained represents colorimeter readings for solutions of ammonia-nitrogen in saliva, and may be used for determining subsequent unknowns. Method affords an accuracy of 8 percent. Ammonia formation in specimen is arrested on mixing with zinc sulfate. Estimations may be performed conveniently and rapidly, and presence of 10 gamma of ammonia-nitrogen is detectable. Dextrose interferes with Nesslerization, but in this dilution effect of small amounts of normal salivary dextrose is apparently eliminated." (Complete paper.)

Price, Weston A., 1932. NEW LIGHT ON THE ETIOLOGY AND CONTROL OF DENTAL CARIES. Jour. dental Res., 12 (3): 540-544.

The author briefly summarizes twelve years of investigation on the relationship between dental conditions and systemic diseases, entailing chemical analyses of saliva, blood, and urine, with emphasis on the influence of calcium and phosphorus levels of blood and saliva.

Price, Weston A., 1932a. THE EXPERIMENTAL BASIS FOR A NEW THEORY OF DENTAL CARIES, WITH CHEMICAL PROCEDURES FOR DETERMINING IMMUNITY AND SUSCEPTIBILITY. Dental Cosmos, 74 (12): 1139-1156.

The relationship between nutrition and caries immunity or susceptibility was studied. As a part of the study, data were assembled on 2000 blood analyses, collected over a period of 12 years, and 400 salivary analyses, collected for 6 years.

Observations were made on the variations in the behavior of the calcium and phosphorus levels of the blood in the presence of powdered bone. When finely powdered bone was placed in normal blood serum, the serum gave up from 30 to 50% of its calcium and nearly as much of its inorganic

phosphorus. Whereas, in certain pathological conditions, the movement of the phosphorus and calcium was in the opposite direction, i.e., from the bone to the serum. Since the chemical content of tooth structure and of bone are alike, the relation between the saliva and the external surface of the tooth was studied in a similar manner.

Comparison of the calcium and phosphorus movement in saliva was studied in three groups of individuals, living under different conditions and in different geographical locations. The chemical analysis of the saliva included the following: "pH, potassium, sodium, total calcium, diffusible calcium, non-diffusible calcium, percent diffusible, saliva plus bone calcium, change from same, percentage change, total phosphorus, inorganic phosphorus, percentage of total phosphorus, that is, inorganic, diffusible phosphorus, non-diffusible phosphorus, percentage of inorganic phosphorus, saliva plus bone phosphorus, change produced by bone, percentage change, product of calcium and inorganic phosphorus, ratio of inorganic phosphorus to calcium, ratio of diffusible calcium."

Based on the data presented a new theory of dental caries was formulated which indicated that both the external and internal environments of the tooth, provided by the saliva and the blood, are different in individuals who are immune to dental caries and those who are susceptible to caries. The degree of immunity and susceptibility may be revealed by observation of the movement of calcium and phosphorus of saliva in the presence of bone. The physico-chemical factors which control caries immunity are discussed.

Price, Weston A., 1933. ADDITIONAL LIGHT ON THE ETIOLOGY AND NUTRITIONAL CONTROL OF DENTAL CARIES WITH ITS APPLICATION TO EACH DISTRICT SHOWING IMMUNITY AND SUSCEPTIBILITY. Jour. Amer. dental Assoc., 20 (9): 1648-1679.

The author reviews his own findings and the published findings of other investigators on the relation of nutrition to dental caries.

One part of the paper deals with field studies conducted in certain European cities, which include results on saliva analyses. Among the factors determined in the saliva were total calcium, inorganic phosphorus, total phosphorus, solvent action of saliva for calcium and phosphorus, and the ratio of calcium to inorganic phosphorus.

Supporting data were obtained which indicate that the condition of immunity to dental caries is associated with physicochemical states of the saliva in which phosphorus passes from the saliva to powdered bone; and in the case of loss of immunity to dental caries, the movement is in the opposite direction, namely, from the bone to the saliva.

Price, Weston A., 1933a. SOME CHEMICAL FACTORS IN SALIVA APPARENTLY RELATED TO ALVEOLAR DECALCIFICATION AND PYORRHEA ALVEOLARIS. Jour. dental Res., 13 (3): 195.

Nine-hundred and sixty chemical analyses of human salivas were made before and after supplementing the diets of the individuals with fat-soluble activators and foods having a high mineral content. "Before treatment, addition of bone to saliva increased the inorganic P, 3.07 percent; after treatment, addition of bone decreased the

reading 13.1 percent, a change of 16.17 percent." No progress of active caries occurred; physical improvement was observed in almost all cases.

Price, Weston A., 1936. ESKIMO AND INDIAN FIELD STUDIES IN ALASKA AND CANADA. Jour. Amer. dental Assoc., 23 (3): 417-437.

The relationship between dental caries, physical degeneration, lowered defense for disease, and facial and dental deformities was studied in isolated groups of Eskimos in Alaska and the Indians in Alaska and northern and central Canada.

The author reaffirms his previously published findings, indicating the presence in the saliva of chemical factors which vary directly with immunity and susceptibility to tooth decay. Interpretations of the chemical analyses of the saliva were based on the principle that in cases with high immunity to dental caries, there is a distinct reduction in the level of inorganic phosphorus of the saliva when shaken with finely powdered bone. A change in the amount of phosphorus is expressed in percentage of indicated quantity found in the duplicate sample as tested without the presence of finely powdered bone. The percentage of change for normal persons is from 20 to 30% decrease. In persons with active caries, the reduction is always less; and in cases of rampant decay, the percentage change is an increase. Instead of the inorganic phosphorus moving from the saliva to the bone, it moves in the opposite direction. For 82 persons with active caries, who had nutrition reinforcement, this factor of the saliva change from an increase of 8.4% to a decrease of 11.2%, which is characteristic of immunity to dental caries.

200 saliva samples were obtained from two groups of persons: one living on native food and the other on imported modern food. Data showed that for 43 persons receiving the modernized diets a movement of the inorganic phosphorus from the powdered bone to the saliva amounted to a plus 9%. For 67 persons living on native food, the inorganic phosphorus of the saliva in the presence of bone showed a decrease of 2.7%.

Price, Weston A., 1936a. CHEMICAL EXPRESSION OF SALIVA RELATED TO IMMUNITY TO DENTAL CARIES. Jour. dent. Res., 15 (5): 371-372.

Previous communications presented data relating chemical factors to saliva to level of individual immunity to caries--two factors shown to be directly related to nutrition (Price, W., 1932n; 1933m; 1936m). Detailed procedures for chemical analysis of saliva in press, in general, relates to behavior of inorganic P when saliva shaken with finely powdered bone. In high immunity to caries, marked lowering of reading for inorganic P for saliva shaken with powdered bone, as compared with reading without powdered bone; whereas, in cases of lost immunity to caries, marked increase in reading for inorganic P, or at least lessened decrease. This procedure in use, in clinical practice for five years, now provides data from 2429 chemical analyses in relation to caries as determined clinically with x-rays. Reinforcement of nutrition, with both fat-soluble activators and natural foods supplying minerals liberally--particularly P--caused, in 121 individuals having caries, salivary increase in inorganic P, averaging 8.9 percent. After this reinforcement, inorganic P in saliva shaken with

powdered bone decreased (when compared with sample without powdered bone) 10.8 percent--total change of 19.7 percent. Coincident with improvement in chemical reaction of saliva, on above basis, roentgenograms revealed increased density of tooth structure associated with cessation of active caries. [Author's abstract]

Price, Weston A., 1939. INHIBITING FACTORS FOR DENTAL CARIES IN SALIVAS. Jour. dent. Res., 18 (3): 246.

The results of 2660 analyses of saliva for its inorganic phosphorus level (Price, W., 1932) were compared with results of 93 coordinated studies of dental caries activity in relation to the behavior of Ca in the presence of sugar, acidophilus bacillus [*Lactobacillus acidophilus*], and yeast, and of the quantity of acidophilus bacillus. A 79.7 percent correlation was found between the inorganic phosphorus and caries levels; less than 50 percent correlation was found between the inorganic phosphorus findings and either the behavior of Ca or total lactobacillus count.

Price, Weston A., 1953. FURTHER DATA ON CHEMICAL FACTORS OF SALIVA RELATED TO IMMUNITY AND SUSCEPTIBILITY TO DENTAL CARIES. Jour. Dental Res., 32 (3): 195.

"The author's further studies have included 960 individual chemical analyses of salivas for persons living in 105 different places distributed through 14 countries. The new data support those previously reported. The treatment consisted of reinforcing nutrition, as previously outlined, with fat-soluble activators and foods having high content of minerals. Before treatment, addition of bone to saliva increased the inorganic P, 3.07 percent; after treatment, addition of bone decreased the reading 13.1 percent, a change of 16.17 percent. In no case has active caries progressed as determined by clinical and roentgenographic study. In practically all cases there was physical improvement with increase of energy." (Author's summary)

Prikhod'kova, E. K., and V. A. Shepeleva, 1937. SEKRETORNIY PROTSESS PODCHELIUSTNOI SLIUNNOI ZHELEZY V SVETE NEIROGUMORAL'NOY TEORII PEREDACHI RAZDRAZHENIYA [The secretory process of the submaxillary gland in the light of the neurohumoral theory of stimulation transmission]. VI Vsesoiuz. S'ezd Fiziol., Biokhim., Farmakol., Tbilisi, Oct. 12-18, 1937: 252-256.

Study was made of the effects of submaxillary salivation produced by changes in frequency of faradic stimulation applied to the chorda tympani of the dog. A high frequency of 150 shocks/second resulted in a long secretory after-effect, lasting up to 20 minutes during which 140 drops of saliva were secreted. Decrease in shock frequency to 100/second reduced the after-effect period to 3-7 minutes, while further decrease to a 2/second frequency reduced this period to 5-10 seconds. Analysis of the saliva elicited by the 150 shocks/second stimulation showed salivary percentages for dry residue of 0.65%, for organic matter of 0.26%, and for ash content of 0.37%. Further experiments showed that administration of physostigmine to the animals prolonged the secretory after-effect of low frequency faradic stimulation; the drug eliminated the after-effect subsequent to high frequency stimulation, inhibiting

salivation from the stimulated gland. Neutral and glandular changes affecting chordal salivation are discussed.

Prikhod'kova, E. K., 1938. ZUR PHYSIOLOGIE DES NEURO-SEKRETORISCHEN PROZESSES [On the physiology of the neuro-secretory function]. Fiziol. Zhur., 21 (5-6), Proceedings of the XV Intern. Physiol. Congress, Leningrad-Moscow, Aug. 9-16th, 1935.

Sympathetic influence on salivary composition was studied in dogs in severe experimentation. Faradic chordal stimulation of varied power and frequency elicited submaxillary secretions with minimal to maximal percentages of organic matter content, at any power level of the current. The higher the frequency, up to a certain optimum, the greater the dry residue, i.e., the organic matter content of the saliva at a determined induction power. If the frequency increases beyond this optimum, the percentage of dry residue begins to decrease.

After low power stimulations at any frequency, saliva containing a relatively low dry residue percentage is secreted. The law of optimum and pessimum stimulation of Vvedenskii (1893) stands not only in regard to the rapidity of secretion, but also in regard to the chemical composition of saliva.

Weak stimulations at low frequency result mainly in what Heidenhain calls "secretory" impulses, eliciting a thin saliva, poor in organic matter. Stimulations of optimal frequency and optimal intensity produce mainly what Heidenhain calls "trophic" impulses, eliciting a viscous saliva, rich in organic matter.

The increase in the rapidity of secretion is usually parallel to the increase in dry residue content after faradic stimulation, although some deviations from this rule do occur.

The same rules apply to stimulations of the sympathetic nerve as to those of the chorda tympani.

Sympathetic stimulation added to chordal stimulation, increases the dry residue content of saliva. The higher the frequency of the faradic stimulation, the larger the dry residue percentage in the saliva. Under certain conditions, an increase in the dry residue of saliva may be observed after stimulation of the sympathetic nerve in the neck during normal rate of chordal secretion.

Pringsheim, Hans and Harald Gorodiski, 1923. ÜBER DIE SEKRETION UND AKTIVITÄT DER SPEICHEL-AMYLASE [On the secretion and activity of salivary amylase]. Biochem. Zeitschr., 140 (1-3): 175-178.

The amylolytic power of human saliva fluctuates not only between individuals but also in the same person. The effect of various stimulants was tested by Bertrand's method on the activity of salivary amylase. A solution was used containing 50 cc. of 2% starch, 2% sodium chloride, and 20 cc. phosphate as a buffer. Saliva samples from two subjects were collected for several weeks and the maltose percentage determined at various intervals under different circumstances. First, 0.5 cc. and 2-4 cc. samples of normal saliva were collected from one person. In the next phase of the experiment, samples were collected: as a regular sample, after having cleaned the teeth with regular toothpaste, and after use

of a radioactive toothpaste, containing 50 and later in turn 500 Mach units. Under all these test conditions both the quantity of the secreted saliva and the amylase activity were similar even when the amount of radioactivity in the paste was increased tenfold.

Pringsheim, H. and K. Schmalz, 1923a. ÜBER DEN GRENZABBAU DER STÄRKE UND EIN KOMPLEMENT DER AMYLASEN [The threshold of amylolysis and a complement of the amylases]. *Biochem. Zeitschr.*, 142 (1-2): 108-116.

A study is reported concerning the various factors affecting amylolysis; determination of the amylolytic activity of saliva is included.

Pritchett, Ida W., and E. G. Stillman, 1919. THE OCCURRENCE OF BACILLUS INFLUENZAE IN THROATS AND SALIVA. *Jour. exper. Med.*, 29 (3): 259-266.

A study was made of the incidence of *Bacillus influenzae* [*Hemophilus influenzae*] in the throats and saliva of 54 influenza convalescents and 177 normal persons. A positive throat culture was noted in 19 convalescents and 54 normal persons; a positive saliva culture was found in 11 convalescents and 44 normal persons.

Prinz, Hermann, 1916. THE THERAPEUTIC EFFICIENCY OF ORAL PREPARATIONS. *Jour. Allied dent. Soc.*, 11 (2): 210-221.

A discourse is given concerning the expectations and criteria of oral preparations for hygienic and therapeutic purposes, with special emphasis on the relationship of such preparations with salivation and salivary functions.

Prinz, Hermann, 1918. THE RELATION OF ORAL SECRETIONS TO DENTAL CARIES. I. METHODS OF DETERMINING THE AMYLOLYTIC INDEX OF HUMAN SALIVA. *Dental Cosmos*, 60 (2): 140-147.

Techniques are discussed for collecting, and diluting human saliva and then mixing with starch suspensions. A colorimetric test using an iodine solution indicates presence or absence of un-reduced starch. The amylolytic index is calculated as the ratio of the quantity of the 1 percent starch solution used to the quantity of saliva employed in the test.

Prinz, Hermann, 1918a. THE RELATIONSHIP OF ORAL SECRETIONS TO DENTAL CARIES. II. CONDITIONS INFLUENCING THE QUANTITY AND ACTION OF THE AMYLASE CONTENT OF HUMAN SALIVA. *Dental Cosmos*, 60 (3): 197-203.

The quantity and to a large extent the quality of secreted human saliva are, within certain limits, considered as directly proportional to the intensity of the stimulant (primarily foodstuffs) and the mechanism of mastication. Laboratory experiments have verified an increase in amylase content of saliva elicited by chewing and swallowing food over food merely chewed. It has also been confirmed that the quantity, quality, and rapidity of response is influenced by the dryness of the food. The quantity of inorganic salts secreted in the saliva is increased with the rapidity of flow while the quantity of organic constituents decreases. It has been found that after a prolonged period of fasting, saliva is usually rich in organic substances. Carbohydrate foods as a rule were found to stimulate in the

dog a saliva rich in organic substances, principally amylase, while a protein meal elicits a saliva which shows no increase in its amylase content over resting saliva.

Saliva was found to have practically lost its amylolytic power after dialyzation with distilled water. Addition of sodium chloride (0.001 to 0.05% solution) or of sodium nitrate reactivated the dialyzed saliva while addition of sodium sulfate, phosphate, or acetate had very little effect on the dialyzed saliva. The author concludes that the enzyme action of saliva depends upon the presence of certain ions, with the amylase and the anion forming a more or less labile complex compound whose activity is determined by the H ion concentration (pH) of the solution. The optimum pH at which salivary enzymes develop maximum activity as shown by the gas chain method are as follows: amylase, 6.7 to 6.9; maltase, 6.1 to 6.8; catalase, 7; and oxydase, 7.

Prinz, Hermann, 1918b. THE RELATIONSHIP OF ORAL SECRETIONS TO DENTAL CARIES. III. FERMENTS OF HUMAN SALIVA OTHER THAN AMYLASE. *Dental Cosmos*, 60 (4): 287-292.

In human saliva very small quantities of maltose usually accompany amylase. Tests for the presence of maltose have generally been unsatisfactory, a rotation test for maltose and a phenylhydrazine test being the most successful. Tests for the oxidizing enzymes of human saliva include a potassium permanganate test for catalase, and an indophenol test for oxydase. Micro-analysis failed to show the presence of sugar in normal or pathological human saliva.

Prinz, Hermann, 1921. THE ORIGIN OF SALIVARY CALCULUS. *Dental Cosmos*, 63 (3): 231-238; (4): 369-374; (5): 503-510; (6): 619-624.

A literature review of the origin of salivary calculi is presented. The author considers that a reduction in CO₂ tension of saliva in the mouth, following secretion from salivary ducts, precipitates calcium salts in the saliva. The resulting deposition of tartar, which may be enhanced by presence of ammonia in the saliva, occurs in suspended colloids of stagnant saliva which form a permanent attachment on rough, sheltered surfaces in the oral cavity. Calculi of similar composition may occasionally occur within the duct of a salivary gland, usually in the submaxillary gland or Wharton's duct, about a nucleus of desquamated epithelium or clump of dead bacteria.

Experiments were conducted to artificially produce tartar. A series of teeth were partially embedded in modeling compound and incubated at 40°C. The artificial "pockets" about the roots were filled daily with fresh saliva. Tartar, considered similar to that occurring naturally in the mouth, was produced after 8 to 10 week periods of such treatment. A similar experiment using an artificial saliva produced the same results. Thin colloidal calcium pellicles were observed to form on the surface of a test tube of fresh saliva, after 1 hour exposure in a small test tube, and then slowly sink to the bottom.

Purr, Arnulf, 1934. THE INFLUENCE OF VITAMIN C (ASCORBIC ACID) ON PLANT AND ANIMAL AMYLASES. *Biochem. Jour.*, 28 (3): 1141-1148.

Salivary amylase is the purest form of alpha amylase; pancreatic and liver amylases are mixtures of alpha and beta types, as are the amylases found in barley and green malt. Tests of the effect of vitamin C on salivary, pancreatic, and liver amylases in Lintner starch, buffered at pH 5.1 and pH 6.8, showed the salivary amylase alone to be unaffected by the ascorbic acid; both the liver and pancreatic amylases were activated by the vitamin C. Ascorbic acid is an activator of the animal type of beta amylase; plant beta amylase is inhibited by the acid, while plant alpha amylase is unaffected by it.

Pushkareva, E. Z., and E. A. Beliâevskaiâ, 1929. K FIZIOLOGII SLIŪNOTDELITEL'NOGO TSENTRA [On the physiology of the salivary center]. Zhur. eksper. Biol. Med., Moskva, 13 (34): 37-42.

Forty experiments were conducted in the dog to study the effects on submaxillary salivation of the stimulatory condition of the salivary center as affected by afferent impulses from the lingual and superior laryngeal nerves. The canine submaxillary ducts were cannulated under chloroform anesthesia, the spinal cord was severed below the medulla oblongata, artificial respiration applied, and the anesthesia discontinued. Determinations were made of salivary flow rate, viscosity, organic and inorganic contents of samples collected at 5-minute and occasionally at one-minute intervals. Section of the cord was shortly followed both by the appearance of a high blood pressure and by a continuous, abundant spontaneous salivation which varied periodically in flow rate from 1.0 to 6.5 cc./5 minutes and in duration from 30 minutes to one hour in various animals. It differed from reflex secretion by having a very low viscosity of 8-25 sec., as well as low dry residue of 0.32-0.7%, low organic matter of 0.23-0.53% and low ash content of 0.07-0.12%; faradically-stimulated saliva had a viscosity of 30 seconds to 11 minutes and a dry residue of 0.59 to 1.79%. Salivary determinations, made before cordotomy, showed chloroform to elicit salivation only at the start of experimentation and then to inhibit flow; cannulation of submaxillary ducts without anesthesia elicited no saliva; faradic stimulation of the oral mucosa evoked considerable salivation. Spontaneous salivation, occasionally noted before cordotomy, was spasmodic and intermittent; the flow ceased after completion of cannulation. Asphyxiation applied for a 3-minute period, 25 minutes after the post-cordotomy salivation had ceased, restored salivary flow for 16 to 30 minutes. Faradic stimulation of the lingual or of the superior laryngeal nerve completely inhibited post-cordotomy salivation which resumed at a lower rate on cessation of stimulation; repeated stimulation caused further inhibition, in some cases permanently. Lingual nerve stimulation also depressed high asphytic secretion of 0.8-1.0 cc./minute down to 0.3-0.2 cc./minute. Reflexes of the lingual nerve were found to be high when spontaneous salivation was low or absent, indicating an increased stimulatory capacity of the salivary center at rest. Intravenous injections of 0.05-0.1 gm./kg. of CaCl_2 markedly increased spontaneous salivation as well as reflex secretion, especially after a second such injection. Subcutaneous injection of 0.01-0.02 gm. of morphine completely inhibited spontaneous and reflex secretions.

Rabieaux, A., 1903. CONTRIBUTION À L'ÉTILOGIE DE LA RAGE [Contribution to the etiology of rabies]. Compt. rend. de la Soc. de Biol. (Paris), 55 (2): 91-93.

Virulence of submaxillary saliva was established in dogs showing first symptoms as well as those in later stages of rabies. In dogs inoculated with rabies in the anterior chamber of the eye, virulence disappeared quickly in the aqueous humor and developed in the saliva before it reappeared in the aqueous humor or the nerve centers.

Rae, James J., 1941. ESTIMATION OF SALIVARY PHOSPHATASE. Jour. dental Res., 20 (5): 453-456.

A quantitative method for the determination of salivary phosphatases is described in detail.

Salivas (4 to 5 ml.) were collected from each of 39 boys and stored at 0° C. for 1 to 2 days, then centrifuged (5 min. at 2000 r.p.m.) and volumes of both the "centrifugate" [supernatant] and precipitate were measured and were analyzed for phosphatase (method described in detail). Ranges were as follows: volume of centrifugate, 3.9 to 9.0 ml; amount of precipitate, 0.03 to 0.50 mg.; phosphatase units/mg. phenol---in the test cases, 0.069 to 0.388 mg. per ml. centrifugate, and in the controls, 0.040 to 0.070; and the precipitate, 0.067 to 0.510 mg. per 0.2 ml.

Rae, James J., and Charles T. Clegg, 1948. CHANGES IN THE CALCIUM AND PHOSPHATE CONCENTRATIONS OF SALIVA AND INORGANIC SALT SOLUTIONS ON SHAKING WITH CALCIUM PHOSPHATE. Jour. dental Res., 27 (1): 54-57.

"Saliva and inorganic salt solutions containing comparable amounts of calcium and phosphate, when shaken with tricalcium phosphate, yield solutions with higher phosphate concentrations and lower calcium concentrations than the original solutions.

"When buffers, ranging in pH from 5.5 to 7.15, were shaken with tricalcium phosphate, the amounts of calcium and phosphate dissolved had no apparent relation to the amounts of calcium and phosphate in the solid. The calcium values obtained decreased continuously with increasing pH; the phosphate passed through a minimum at pH 5.5.

"Inorganic salt solutions containing calcium and phosphate, when shaken with calcium phosphate, showed an increase in both calcium and phosphate at a low pH, but at a higher pH the calcium decreased and the phosphate increased. Analogous results were obtained with saliva.

"These experiments lead us to conclude that variations in concentration of calcium and phosphate of salivas, produced by shaking these salivas with calcium phosphate, bear little if any relation to the Ca/P ratio of the calcium phosphate used. The pH of the saliva or solutions used seems to be the deciding factor in determining whether the calcium concentration increases or decreases on shaking with calcium phosphate." (Authors' summary and conclusions.)

Rae, James J., Charles T. Clegg, 1949. THE RELATION BETWEEN BUFFERING CAPACITY, VISCOSITY, AND LACTOBACILLUS COUNT OF SALIVA. Jour. dental Res., 28 (6): 589-593.

Two series of determinations (one in October, the other in December) were made on the buffering capacity, lactobacillus count, and viscosity of stimulated-saliva samples from 62 persons and

attempts at correlations were made. Methods of procedure are described in full.

The buffer capacity varied for the same individual between the two series. A positive rank correlation, however, was indicated between the series in that high values tended to remain high and low values, low. There was no evidence of positive rank correlation between buffering capacity and lactobacillus counts, nor between viscosity times (Ostwald-Fenske method) and lactobacillus counts. The viscosities of the saliva, with few exceptions, tended to approximate 58.5 seconds; variations were insignificant. The authors consider it inadequate to calculate the viscosity on the basis of these variations, which may have been due to experimental error, since the saliva densities were notably constant.

Rae, James J., 1952. AMMONIA PRODUCTION IN SALIVA. *Jour. Dental Res.*, 31 (4): 469.

"In a previous report it was found that the ammonia producing ability of saliva reached a maximum in 24 to 48 hours on incubation at 37°; was independent of whether the saliva was stimulated or unstimulated; was inhibited by sodium fluoride; was irreversibly activated on heating to 50° for 24 hours and was removed by filtering the saliva through a Seitz filter or a fritted-glass funnel (*J. D. Res.* 30: 385, 1951). The present investigation extended this study to 66 salivas which were divided into 3 groups on the basis of lactobacillus counts. It was found that the activity of the ammonia producing mechanism was unrelated to the lactobacillus count. The urease content of saliva was also found to be unrelated to the lactobacillus count. The relation between urease activity and ammonia production in saliva was not a significant one. In all cases the presence of 2.5 percent glucose was found to stimulate the ammonia production in the presence of urea." (Author's abstract)

Rae, J. J., H. M. Shemilt, and C. T. Clegg, 1955. AMMONIA PRODUCTION IN SALIVA. *Jour. Dental Res.*, 34 (6): 886-888.

In a continuation of previous studies on the effects of glucose on salivary production of ammonia (Ballantyne, 1951, 1952), the incubation of saliva at various pH values for 24 hours indicated the optimum pH range for ammonia production to be from 6.5 to 7.0. Incubation of 2 ml. salivary samples buffered at pH 7.0, with and without addition of 1 ml. of 20% glucose, showed the glucose to inhibit ammonia production even when the samples were buffered at pH 7.0; the pH did not drop below the optimum range. Incubation of 2 ml. salivary samples, containing 1 ml. of 20% glucose, showed the glucose to stimulate ammonia production in the saliva-urea mixture. These results indicate that the stimulatory effect of the glucose could be attributed to acid, keeping the pH near the optimum for ammonia production.

Rae, J. J., and C. T. Clegg, 1956. LACTIC ACID PRODUCTION IN SALIVA. *Jour. Dental Res.*, 35 (4): 612-614.

The lactic acid production of 6 zero-count (lactobacillus index) salivas was measured by incubating mixtures, containing 1 ml. of such salivas, 4 ml. buffer, and 1 ml. of 10% glucose and water to 10 ml., at 37°C for 24 hours. Results

showed a considerable production of lactic acid varying from 14.3 to 45.7 mg./100cc. Similar tests using salivas with variable lactobacillus counts showed no apparent relation between the count and the amount of acid produced.

The pH of saliva incubated at 37°C rose from 7.0 to 8.0 after 18 hours in the absence of glucose; addition of 0.1% or more glucose caused a drop in pH. The optimum pH for lactic acid production in the presence of 1.0% glucose was found to be 6.5. Addition of urea to saliva-glucose mixtures kept the incubation mixture above pH 7.0, and appeared to enhance lactic acid production.

Rapp, Gustav William, 1946. THE BIOCHEMISTRY OF ORAL CALCULUS. II. THE PRESENCE OF CARBONIC ANHYDRASE IN HUMAN SALIVA. *Jour. Amer. med. Assoc.*, 33 (3): 191-194.

Using the methods of Meldrum and Roughton (*Jour. Physiol.* 80: 113, 1933) and of Keilin and Mann (*Biochem. Jour.* 34: 1163, 1940), the presence of carbonic anhydrase was demonstrated in human saliva. This enzyme can accelerate both the uptake and the liberation of carbon dioxide; it may be almost completely inhibited by a 0.001 molar concentration of sulfanilamide and potassium thiocyanate, the latter being of importance since this substance is often found in human saliva. The significance of carbonic anhydrase in the etiology of oral calculus is suggested; the enzyme may speed the removal of CO₂ from saliva near the salivary ducts, thereby alkalizing the saliva and allowing the precipitation of calcium salts on dental surfaces. The precipitate may develop into dental calculi.

Rapp, Gustav W., and G. C. Richardson, 1952. A SALIVA TEST FOR PRENATAL SEX DETERMINATION. *Science*, 115 (2984): 265.

Tests were made of the salivary estrone levels of pregnant women. Of 225 positive tests obtained during the 6th and 7th months of pregnancy, 218 of the mothers had sons and 7 had daughters. Conversely, 151 negative tests during the same period of pregnancy were correlated with 148 daughters and 3 sons born to these women. In non-gravid females, the injection of testosterone or androsterone resulted in a strongly positive test; male saliva, spermatic fluid, and blood serum are all positive reactors. Apparently the female salivary glands during pregnancy, screen out female-associated hormones, but allow male-associated hormones to pass into the salivary fluid. Here, they are detected by the Richardson test; hence, the high correlation with the birth of a male child.

Rapp, G. W., and B. Dusza, 1954. A SCREENING TEST FOR MUCIN ADSORBING ENZYME INHIBITORS. *Jour. Dental Res.*, 33 (5): 683.

Freshly-gathered human saliva is used in a method of studying enzyme inhibitors which adsorb on mucin. A solution of the test inhibitor is added to the saliva which is then centrifuged sharply. Substrate-containing solutions are added to the resultant precipitate, with changes in the substrate being measured after suitable periods of incubation. Differences in the adsorbing capacity of native and altered mucin were found. Typical examples of effective and ineffective inhibitors against glycolytic and proteolytic enzymes were given. (From Author's abstract)

Ratcliffe, A. W., 1936. CELL GROUP IDENTIFICATION OF DRIED BLOOD SPOTS AND TRACES OF SALIVA. *Jour. Lab. clin. Med.*, 22 (2): 191-198.

A technic for demonstrating agglutinogens in dried samples of blood and of saliva is fully described. Twenty-six (86.7%) of 30 saliva samples were correctly grouped by the agglutinin fixation test; 3 results (10%) were erroneous (false negatives); and 1 (3.3%) gave a doubtful diagnosis. The deteriorative effect of age and exposure on the agglutinins is noted.

Rathje, Werner, 1951. SYMPATHICOTONY OF THE SALIVARY GLANDS AS A CAUSE OF DENTAL CARIES. *Jour. dent. Res.*, 30 (6): 783-786.

A study was made of the effect of incubating large and small pieces of white bread inoculated with oral acidogenic bacteria in agar of different concentrations and viscosity. Results indicated that acids originating in the bread were neutralized and eliminated more completely in less viscous agar solutions, with smaller bread lumps, and if the convection and diffusion of the agar solution is not impeded. The theory is advanced, based on these results, that a relationship exists between caries activity and saliva viscosity and flow.

A further study was made of the unstimulated salivary rate of flow and viscosity in 101 individuals. These results indicated a higher rate of secretion of saliva and a lower average viscosity of the saliva of caries-resistant subjects in comparison with caries-susceptible individuals. Psychic and physical influences on salivary production are considered to be important factors in this correlation.

Rathje, Werner, 1956. OVERSATURATION OF SALIVA WITH HYDROXYAPATITE. *Jour. dent. Res.*, 35 (2): 245-248.

An in vitro study was made of the influence of hydroxyapatite (HA) upon the calcium and phosphate content of stimulated (by chewing rubber) and unstimulated saliva from 10 subjects free of dental caries and periodontal disease. Determinations were also made of the pH (phenolphthalein-methyl red colorimetric tests), and of the buffering capacity (cc. of N10 HCl to change 1 cc. saliva from pH 8.5 to 5.5) of these salivas.

In the tests 10 mg. of pure precipitated HA and a drop of HgCl_2 were added to each 2.5 cc. of saliva, prior to incubation at 37°C. for 20 hours with frequent stirring and shaking. Two cc. of the supernatant, after centrifugation to remove apatite and opaque saliva, was analyzed for dissolved Ca; a weighed drop of the supernatant was analyzed for inorganic phosphate.

Results show no significant difference in the Ca^{+} and P^{-} content of unstimulated (10.9 mg. $\text{Ca}/100 \pm 0.8$; 14.1 mg. $\text{PO}_4/100 \pm 0.8$) and of stimulated (11.8 mg. $\text{Ca}/100 \pm 0.8$; 15.5 mg. $\text{PO}_4/100 \pm 1.1$) saliva. Samples of unstimulated saliva were more acid (pH 6.0), than samples of the stimulated saliva (pH 6.5), and had a stronger buffering capacity (0.32 compared to 0.13). Decreases were noted in the Ca^{+} content (5.5 $\pm$ 0.9) and P^{-} content (3.3 $\pm$ 0.5) of unstimulated salivas after 20 hours contact with HA; greater decreases were found in the Ca^{+} content (7.8 $\pm$ 0.8) and P^{-} content (5.8 $\pm$ 1.3) of the stimulated salivas. The greater decrease in the stimulated saliva is considered due to the fact that both

kinds of saliva represent oversaturated solutions in which hydroxyapatite is crystallized by the addition of hydroxyapatite crystals. Unstimulated saliva has a higher dissolving capacity, due to its lower pH and higher buffering power, and is consequently less oversaturated than stimulated saliva.

Razran, Gregory, 1949. SENTENTIAL AND PROPOSITIONAL GENERALIZATIONS OF SALIVARY CONDITIONING TO VERBAL STIMULI. *Science*, 109 (2835): 447-448.

A report is presented of a study on conditioned response of salivation to sentences of a political nature.

Ream, William J., 1921. SOLUBLE SALTS IN SALIVA AND URINE. *Jour. dental Res.*, 3 (4): cxxxi-cxxxii.

Salt crystals were obtained from saliva by the method suggested by Dr. J. P. Michaels and 72 photographs were made with polarized light.

The various crystallizing components were identified as follows:

The chlorides of sodium, potassium, ammonium were the salts commonly isolated from saliva. Ammonium chloride was predominant.

Of interest were crystals, similar to those of acid lactates, which were separated from acid salivas. Soluble oxalates were noted; crystals closely resembling sodium oxalate were yielded by salivary creatinin under certain conditions [not specified].

Reichert, Frederick Leet, and Edgar J. Poth, 1933. PATHWAYS FOR THE SECRETORY FIBERS OF THE SALIVARY GLANDS IN MAN. *Proc. Soc. exper. Biol. Med.*, 30 (7): 973-977.

"1. The rates of secretion of the salivary glands in man after unilateral section of the ninth nerve and chorda tympani indicate peripheral pathways for secretory fibers to these glands other than those accepted. 2. Section of the ninth nerve intracranially causes marked temporary diminution of salivation with partial recovery involving parotid, sublingual and submaxillary glands. 3. Section of the chorda tympani in the tympanic membrane causes marked permanent diminution of salivation involving the parotid, sublingual and submaxillary glands. 4. Therefore, it is concluded that the salivary glands receive their secretory fibers from both the seventh and ninth nerves." (Authors' summary).

Reid, Jane, W. Hawkins, and W. Pigman, 1955. CARBOHYDRATES OF HUMAN SALIVA. *Jour. Dental Res.*, 34 (5): 764-765.

The presence of glucose in human saliva was investigated by paper chromatographic analysis of whole saliva and of the separately collected salivas of the submaxillary, sublingual, and parotid glands. Analyses of ethanol extracts of the lyophilized salivas showed no evidence for the presence of any glucose or other simple aldoses or ketoses. If present in saliva their concentration must be less than about 5 mg./100 cc. These results were confirmed by determinations of the reducing power of the ethanol extracts and of the deproteinized saliva. All salivary secretions have a reducing power, which usually is ascribed to the presence of sugars. This reducing power varies for the individual salivas, submaxillary and parotid showing much less power than

whole saliva. Sublingual and accessory gland secretions exhibit much reducing power, probably accounting for a large portion of such power in whole saliva. Mucin may account for some of the salivary reducing power especially in submaxillary and in sublingual secretions; the other reducing materials are unknown. [From authors' abstract].

Reindel, W., 1940. ÜBER DIE GESETZMÄSSIGE GEGENSÄTZLICHKEIT ZWISCHEN DEN ACIDITÄTS VERHÄLTNISSEN VON MUNDSPEICHEL UND MAGENSÄFT [On the consistent antagonism between conditions of acidity in the oral saliva and in the gastric juice]. Klin. Wochenschr., 19 (17): 390-392.

The relationship of hydrogen ion concentration of mixed saliva to gastric juice secretion in normal and pathological conditions is discussed. Subjects cleaned their mouth before going to bed; the next morning without further cleaning, 2-3 cc. of fasting saliva was collected. The natural saliva was colorimetrically examined for hydrogen ion concentration. Immediately after, portions of the stomach contents were removed. Following aspiration of the fasting gastric juice, 250 cc. 5% alcohol was ingested which was recovered at 10 minute intervals. Then, the combined acidity was calculated; for control purposes the fasting salivary pH was checked again the following morning. Among 50 subjects examined 12 had a normal degree of acidity, 22 showed in acidity or hypoacidity, and 15 had hyperacidity. In 10 (85%) of the "normal" cases, the hydrogen ion exponent decreased from 6.9 to 7.1. Lower pH values were found only in two cases of severe blood disease. Subjects having a condition of in acidity or hypoacidity showed contrary reactions to salivary and to gastric acidity. Among the 22 cases examined in 17 (79% of cases) and acid salivary pH value fluctuated between 5.9 and 6.8. In 15 cases (73%) of hyperacidity, a variation from 7.2 to 8.4 was seen.

A comparison of the hydrogen ion values of the fasting saliva with those noted after the fractional removal of the gastric contents showed that in 78% of the cases examined, the salivary pH value was 6.9-7.1 in the presence of gastric juice having a normal acid ratio, under 6.9 in in acidity and hypoacidity; and over 7.1 in case of hyperacidity.

Remlinger, P., 1904. LA SALIVE D'UN HOMME ATTEINT DE RAGE EST-ELLE VIRULENTE? [Is the saliva of a person with rabies virulent?]. Compt. rend. de la Soc. de Biol. (Paris), 56 (3): 107-108.

The saliva of 2 persons, showing first signs of rabies after being bitten by a mad wolf 26 days earlier and after 14 days of treatment, was collected for 2 days, diluted with 100 cc. of water and then filtered through a Berkefeld V filter. 8 rabbits inoculated under the dura mater with 1 cc. of the filtrate did not develop rabies. 10 tubes of broth heavily seeded with the filtrate (5 kept at 37°C, 5 at room temperature) showed no signs of development. 2 rabbits which had received subcutaneous injections (2-5 cc.) of an emulsion of the non-filtered saliva showed no signs of rabies 2 months later.

Remlinger, P., 1904a. LA SALIVE RECUEILLIE CHEZ LES ANIMAUX ENRAGÉS APRÈS INJECTION DE PILOCARPINE N'EST PAS VIRULENTE [Saliva of rabies-

infected animals collected after injection of pilocarpine is not virulent]. Compt. rend de la Soc. de Biol. (Paris), 57 (29): 309-310.

Saliva from rabid animals (rabbit, dog, sheep) collected after pilocarpine stimulation was injected into the nuchal muscles of 26 guinea-pigs and 37 rabbits without causing rabies.

Remlinger, P., 1907. PERSISTANCE DUE VIRUS RABIQUE DANS LA SALIVE DU CHIEN GUÉRI DE LA RAGE [Persistence of rabies virus in the saliva of the dog after recovery from rabies]. Compt. rend. de la Soc. de Biol. (Paris), 62 (15): 800-802.

Inneculation of guinea pigs showed persistence of the virus in dog saliva 8 days after recovery from rabies.

Rénon, , 1896. RECHERCHE DES SPORES DE L'ASPERGILLUS FUMIGATUS DANS LE MUCUS NASAL ET LA SALIVE DE PERSONNES SAINES ET MALADES [A study of *Aspergillus fumigatus* spores in nasal mucus and in saliva of healthy and diseased persons]. Compt. rend. de la Soc. de Biol. (Paris), 48 (15): 456-459.

A study of nasal mucus and saliva of 8 healthy and 50 sick persons revealed the presence of spores of *Aspergillus fumigatus* in the nasal mucus of 5 persons and in the saliva of one other.

Rénon, , 1897. RECHERCHE DU PLOMB DANS LES GLANDES SALIVAIRES AU COURS DE L'INTOXICATION SATURNINE AIGUE EXPÉRIMENTALE [Research on lead in salivary glands in the course of acute experimental lead-poisoning]. Compt. rend. de la Soc. de Biol. (Paris), 49 (29): 862-863.

Traces of lead were found in salivary glands of 2 guinea pigs of a group of 10 which died as a result of lead poisoning experiments.

Retterer, Éd., and Aug. Lelièvre, 1913. DE LA NATURE ET DE L'ORIGINE DES CORPUSCULES SALIVAIRES [On the nature and origin of the salivary corpuscles]. Compt. rend. de la Soc. de Biol. (Paris), 74 (12): 667-670.

Fresh saliva contains fragments of mucous cells whose swollen hyaloplasm has been transformed into mucus and whose reticulum has been broken down into granules. Saliva also contains free cells. These are derived from the nucleus and the perinuclear portion of the mucous cell and are set free under the form of polymorphonuclear leucocytes and lymphocytes to become the salivary corpuscles. The amoeboid movements attributed to them result from hydration and a partial liquefaction of the cytoplasm.

Richardson, R. L., and M. Jones, 1958. A BACTERIOLOGIC CENSUS OF HUMAN SALIVA. Jour. dent. Res., 37 (4): 697-707.

A census of 14 bacterial groups has been obtained by cultural methods from unstimulated saliva of 14 adults. The saliva of each subject examined on 10 separate occasions. The group mean for the various categories may be expressed as high, intermediate, and low populations. High population means ($n \times 10^6$ per ml. saliva) were: total anaerobes 110, total aerobes 40, total streptococci 18, Veillonella 17, *S. salivarius* 11, starch hydrolyzers 5, hydrogen sulfide-producers 2, and Neisseria 2. A total micrococcus population was estimated to be about that of the Neisseria. Intermediate population means ($n \times 10^3$

per ml. saliva) were: fusobacteria 56, lactobacilli 35, salt-tolerant micrococci 5, and Leptotrichia 3. Low populations ($n \times 10^2$ per ml. saliva) were: Candida 2 and coliforms 1. The Veillonella, total anaerobes and total aerobes were categories in which the least fluctuation occurred from examination to examination for all of the subjects. No statistical differences were found between vegetarians and non-vegetarians for any of the categories. Certain characteristics were identified with subjects exhibiting low counts as opposed to those exhibiting high counts. Thus, females had lower counts than males, slow spitters had lower counts than fast spitters, and nonsmokers or occasional smokers had lower counts than smokers. Population counts of salt-tolerant micrococci, Neisseria, Leptotrichia, fusobacteria, and hydrogen sulfide-producers provided an index of gingival health. Subjects with statistically significant high counts in one or more of these categories had varying degrees of gingivitis and calculus deposits, whereas subjects with significantly low counts had clinically healthy gingiva and little or no calculus. (Author's summary)

Richins, C. A., and A. Kuntz, 1953. ROLE OF SYMPATHETIC NERVES IN THE REGULATION OF SALIVARY SECRETION. *Amer. Jour. Physiol.*, 173 (3): 471-473.

Changes are described in salivary secretion from the parotid and submandibular glands in the cat, produced by direct sympathetic or reflex parasympathetic electrical stimulation in the presence and absence of glandular blood supply, with and without intravenous injections of ergotoxine or atropine.

Rickert, U. G., and Faith Palmerlee, 1924. A COMPARATIVE STUDY OF TOTAL SALIVARY AND BLOOD CALCIUM IN VARYING TYPES OF INDIVIDUALS WITH SPECIAL REFERENCE TO CASES OF PREGNANCY. *Jour. Amer. Dent. Assoc.*, 11 (9): 783-791.

Analysis of the calcium content of saliva and of blood in 31 normal subjects showed a greater variation in the calcium content of saliva than that of blood; no appreciable correlation was noted between variations in the two fluids. Examination of calcium content of blood and saliva in 25 cases of pregnancy showed the average salivary calcium content in these cases (.00149 g. CaO/25 cc. serum) to be lower than in the non-pregnant group (.00266 g.); the blood calcium levels were also found lower among the pregnancy cases. No direct correlation between the calcium content of the two fluids was noted among the pregnancy cases either before or, in 15 of the 25 cases, 10 days after delivery.

Rickles, N. H., 1951. THE EFFECT OF A TOPICAL APPLICATION OF A 2 PERCENT SOLUTION OF NaF ON THE ORAL FLORA OF YOUNG ADULTS. *Jour. dental Res.*, 30 (4): 519.

"An experimental group of 97 patients had their saliva samples incubated with a sucrose-indicator mixture, with a drop in pH of each sample being recorded each hour for 7 hours and the total acid produced at the end of the 7 hours measured in terms of cc.'s of 0.02 N NaOH. A control group of 46 individuals similarly had their salivas evaluated for acidogenic properties. The experimental group then had 4 weekly applications of an aqueous 2 percent solution of NaF to

all their teeth, while the control group had 4 weekly applications of distilled water. One week after the final application all salivas of both experimental and control groups were again examined for the acidogenic properties of the oral flora. The differences in pH between the original and final samples at each hour and total acid at the end of 7 hours in each case was noted. On inspection it appeared that the experimental group's saliva had, on the average, produced less acid than had the control group. On statistical evaluation, these differences between the amounts of acid produced by the experimental and control groups after application of the 2 percent NaF and distilled water, respectively, to the teeth were found not to be significant. The lactobacillus counts of the experimental and control groups were recorded before and after the application to the teeth of the 2 percent NaF and distilled water, respectively. No significant difference existed between the mean increase of lactobacilli in the experimental and control groups." (Complete paper.)

Rickles, Norman H., 1952. THE ESTIMATION OF DENTAL CARIES ACTIVITY BY A NEW COLORIMETRIC TEST. *Jour. dental Res.*, 31 (4): 467.

"It was the purpose of this investigation to evaluate: (1) The accuracy and practicability of a new colorimetric test for the determination of dental caries activity and future dental caries increment; (2) the degree of correlation of the [Lactobacillus acidophilus] index and total titratable acid (of an incubated saliva-sucrose mixture) with the dental caries increment; and (3) the relationships which may exist among the three tests. Clinical and bite-wing roentgenographic dental examinations were made of 135 students (mean age, 22); the findings were recorded according to the modified Boedecker dental caries index. Early morning saliva samples were collected for the following determinations: (1) The pH of each of the saliva samples, when mixed and incubated with a sucroindicator solution and compared with standard color tubes; (2) the total titratable acid of each of the above mixtures; and (3) the L. a. index. One year later the dental examinations were repeated under identical conditions, plotted against the initial laboratory tests and subjected to statistical analysis: (1) The lower the pH of the saliva-sucrose mixture, the more dental caries occurred during the ensuing year; (2) the more total titratable acid produced, the greater the dental caries increment; (3) the dental caries increment could be predicted (within definite limits) for the higher the L. a. index, the greater the increase in dental caries; (4) individual dental caries increment could be predicted (within definite limits) for the following year if no dietary changes were made; (5) the new colorimetric pH test and the determination of total titratable acid were equally accurate in their prognostic abilities." (Complete paper.)

Rizzo, Dorothy R., and Evelyn B. Tilden, 1952. FURTHER STUDIES OF A DIFFERENTIAL CULTURE TECHNIQUE FOR ESTIMATION OF ACIDOGENIC BACTERIA IN SALIVA. I. COMPARISON WITH CONVENTIONAL TECHNIQUES AND CONCURRENT CLINICAL EXAMINATIONS. *Jour. dental Res.*, 31 (6): 825-830.

A striking direct relationship between the number of salivary lactobacilli and the degree of

caries activity was observed in 140 orphanage children, 3-11 years of age over a one-year (87 children) to two-year (53 children) period. Statistical comparisons were made by the tomato agar count, the Synder test, and the acidogenic count of Davies, Slack, and Tilden (*Jour. dental Res.*, 27: 149. 1948.).

Of interest were three cases of dental caries in the apparent absence of lactobacilli.

Robb, E. F., Grace Medes, J. F. McClendon, Margaret Graham, and I. J. Murphy, 1921. A STUDY OF SCURVY AND ITS BEARING ON THE PRESERVATION OF THE TEETH. *Jour. dent. Res.*, 3 (1): 39-61. Abstract: *Jour. dent. Res.*, 3 (1): 3.

"It was found, that an acid-forming diet (that was also a scorbutic diet) caused a depletion of the alkaline reserve of the saliva (and blood) in man, thus impairing the power of the saliva to neutralize oral (fermentation) acidity and presumably reducing the protective action of saliva against caries." (From the Authors' abstract)

Robbins, B. H., 1935. EFFECT OF VARIOUS ANESTHETICS ON SALIVARY SECRETION. *Jour. Pharmacol. and exper. Therap.*, 54 (4): 426-432.

In a study of the effect of anesthesia on salivation Stenson's duct of each of thirty dogs was cannulated and the rates of parotid gland secretion were measured during the induction, anesthesia, and recovery periods. The drugs tested were ether, chloroform, cyclopropane (25-40%), ethylene (90%), nitrous oxide, barbital, amyral, and evipal. These were introduced intravenously, rectally, tracheally, by the cone method, and/or via CO₂ absorption techniques.

Ether vapor increases salivation during the induction and recovery phases of anesthetization if the ether is allowed to stimulate the sensory nerve endings in the buccal or upper respiratory mucosa. All of the anesthetics tested stop salivation during anesthesia. Experimental findings suggest that depression of the medullary center or nervus intermedius is responsible for the cessation of secretion, and that the irritational effects upon salivary secretion vary with different anesthetics.

Robbins, N. F., 1940. GALVANIC ACTION IN THE ORAL CAVITY. *Jour. dental Res.*, 19 (3): 291.

"The most important of several factors in the production of galvanic action is the presence of 2 or more dissimilar metals in an electrolyte. Such a condition is frequently found in the oral cavity. After consultation it was decided to use an apparatus and method to obtain micro-voltage rather than micro-ampere readings. Clinical patients were observed and varying objective and subjective symptoms recorded. In some instances pronounced reactions were noted with relatively low electro-potentials. Only removal of one of the dissimilar metals brought relief in certain individuals. In the range of normal intra-oral pH values significant changes in micro-voltage was not demonstrable. The pathway of current varies in each individual and depends largely on resistance offered to its passage. Current probably does not flow continuously but may pass momentarily when conditions are favorable." (Complete paper.)

Roberts, E. A. H., B. G. Maegraith, and H. W. Florey, 1938. A COMPARISON OF LYSOZYME PREPARATIONS FROM EGG-WHITE, CAT AND HUMAN SALIVA. *Quart. Jour. exper. Physiol.* 27 (4): 381-391.

Purified lysozymes from cat and human saliva were prepared, and were compared with egg-white lysozyme by various methods.

The cat saliva was collected in two ways: (1) Pilocarpine intrate was injected intravenously (at approximately 1/2 hour intervals) into anesthetized cats and the resultant flow of saliva was collected. One cat yielded as much as 300 cc. A comparison of the saliva samples showed that each pilocarpine injection was followed first by a rapid rise and later by a rapid fall of the lysozyme level. Towards the end of the experiment (usually after the first 200 cc.), the lysozyme content per cc. was diminished, the fluid secreted now being mainly water. (2) Cats, anesthetized with nembutal, were given .65 mg. eserine solution, followed by another dose in 20 minutes. 5 mg. of acetylcholine were given subcutaneously 10 minutes later. The saliva yield of this method was from 60 to 120 cc. in 2 to 2-1/2 hours.

The total lysozyme yield from 2752 cc. of cat saliva was 110 mg.; 3900 cc. of human saliva yielded 50 mg. of an active preparation.

A comparison of the bacteriolytic properties of cat-saliva lysozyme with egg-white lysozyme showed much similarity. There was, however, chemical evidence of a difference between the two. The best preparation of cat saliva contained 16% N and 1.36% S against 13.3% N and 1.94% S in the egg-white lysozyme.

A similar comparison using human lysozyme was impossible because the human saliva preparation was not of a sufficiently high grade of purity.

A sharp serological difference between the lysozymes was demonstrated. 20 mg. of egg-white lysozyme in saliva were injected in two fully grown rabbits. One rabbit produced a much stronger serum than the other. A serum was obtained from one rabbit which precipitated egg-white lysozyme when the antigen was diluted 1:1,000,000. It appears to the author that this end-point is the highest yet recorded for anti-enzyme serum.

From the precipitin tests, it was seen that a difference exists in the reactions of the three lysozymes from cat, egg-white, and human sources; they are, therefore, not exactly similar substances.

Roberts, P. J. P., and W. J. Whelan, 1951. END PRODUCTS OF THE ACTION OF SALIVARY α -AMYLASE ON AMYLOSE. *Biochem. Jour.*, 49 (Proc.): lvi.

Salivary α -amylase hydrolyzes potato amylose to a mixture of reducing sugars having a reducing value of 90.0% apparent maltose; maltose and maltotriose are found to be the end products. Salivary α -amylase is without action upon the maltose or the maltotriose. Thus, it differs from pancreatic amylase which has been found to hydrolyze maltotriose to maltose and glucose.

Roberts, P. J. P., and W. J. Whelan, 1952. ACTION PATTERN OF SALIVARY α -AMYLASE. *Biochem. Jour.*, 51 (3): xviii.

A study was made of the fractionated end-products of the action of salivary α -amylase on malto-tetraose, malto-heptaose, malto-pentaose,

and malto-hexaose. No products were detected other than maltose and maltotriose, and the salivary enzyme did not produce slow alpha-amylolysis of maltotriose.

Robertson, William van B., M. W. Ropes, and W. Bauer, 1940. MUCINASE: A BACTERIAL ENZYME WHICH HYDROLYZES SYNOVIAL FLUID MUCIN AND OTHER MUCINS. Jour. biol. Chem., 133 (1): 261-276.

Mucinase, isolated from broth cultures of *Clostridium perfringens*, hydrolyzed the mucins of vitreous humor, umbilical cord, and connective tissue, but did not hydrolyze the mucin of human saliva.

Rocchi, F., 1930. LE ALTERAZIONI CHIMICHE DELLA SALIVA PAROTIDEA NELLA PAROTITE EPIDEMICA [The chemical changes in the parotid saliva in epidemic parotiditis]. Policlinico, Sez. med., 37 (11): 509-532.

Literature data on the chemical composition and amylolytic activity of normal human saliva are reviewed. The author collected parotid saliva of mumps patients by cannulation. The salivary flow was, generally, greatly reduced. Salivation was stimulated with citric acid or with injection of 0.1 g. of pilocarpine hydrochloride. Analyses were made for Ca (method of Kramer and Tisdall), chlorides (method of Volhard), thiocyanates (method of Reissner) and amylolytic power (method of Carnot and Mouban); complete descriptions of the methods are given. Saliva of healthy subjects served as control. 9 pages of detailed data and 4 graphs are presented.

The Ca content (normal, 9 mg. per 100 cc. saliva) was augmented up to the 14th or 15th day, then diminished again and reached the normal level by the 27th to 30th day after the beginning of the disease; the chloride content followed a similar course; sulfocyanate (thiocyanate) and amylolytic power were not appreciably affected. 92 ref.

Rockwood, Elbert W., 1917. SOME NITROGENOUS AUXOAMYLASES. Jour. Amer. chem. Soc., 39 (12): 2745-2751.

Alpha amino acids, both cyclic and acyclic compounds, act as auxoamylases with regard to ptyalin by augmenting the power of the salivary ferment to hydrolyze boiled starch. The activity of these proteins increases as the number of free amino groups is increased by hydrolysis.

Rockwood, Elbert W., 1918. THE ACTION OF AMMONIUM COMPOUNDS ON PTYALIN. Jour. biol. Chem., 33: ix-x.

The activity of ptyalin was found to be increased by both the ammonium salts of inorganic and strong organic acids, the ammonium salts of weak organic acids being less effective. Oxalic acid, however, had little or no effect on the activity of ptyalin.

Rockwood, Elbert W., 1919. THE EFFECT OF NEUTRAL SALTS UPON THE ACTIVITY OF PTYALIN. Jour. Amer. chem. Soc., 41 (2): 228-230.

The effects of various salts upon the digestive activity of ptyalin were studied. Salts of hydrochloric, hydrobromic, and nitric acids (strong acids) were found to cause the greatest increase in the hydrolytic action of ptyalin on starch. The salts of hydrofluoric, acetic, and

tartaric acids (weak acids) had but little or no effect on the digestive processes, and the salts of oxalic acid were inert. Comparative data indicates that variations in the valences of the cations Na, K, and Ca had no effect upon the reaction processes.

Rockwood, E. W., and A. K. Keltch, 1926. THE PROMOTER ACTION OF ADRENALIN ON PTYALIN. Jour. biol. Chem., 67 (2): lvi-lvii.

A study was made of the effects of adrenalin on the hydrolysis, by ptyalin, of starch, liver glycogen, and pulped liver. The hydrolysis of starch (in relatively large amounts) was increased in proportion to the amount of natural adrenalin, adrenalin hydrochloride, or synthetic adrenalin; a similar effect was noted with liver glycogen, but pulped liver or pulped liver plus liver glycogen showed no response.

Rodriguez, F. E., 1930. A METHOD OF DETERMINING QUANTITATIVELY THE INCIDENCE OF LACTOBACILLUS ACIDOPHILUS-ODONTOLYTICUS IN THE ORAL CAVITY. Jour. Amer. dental Assoc., 17 (9): 1711-1719.

A method is described for the quantitative estimation of *Lactobacillus acidophilus-odontolyticus* [*L. odontolyticus*] contained in a definite amount of human salivary inoculum.

Paraffin-stimulated saliva is collected in a sterile petri dish. 0.1 cc. of the collected saliva is transferred to a tube containing 9.9 cc. of glucose broth (pH 5.8), and the contents are thoroughly mixed. Then 1 cc. of the mixture is transferred to another tube containing 9 cc. of broth; and again 1 cc. of the mixture from the second tube is transferred to a third tube containing broth, thus providing three dilutions of the original salivary inoculum - 1:100, 1:1000, and 1:10,000 dilutions. 0.1 cc. portions from each tube are spread over surfaces of serum-agar plates. The inoculated plates are then placed inside a Brown anaerobic jar; the jar sealed; and the air within the jar partially exhausted by means of a suction pump. A volume of carbon dioxide equal to 10% of the capacity of the jar is added. The jar with the plates is then incubated for 2 or 3 days at 37.5°C. After incubation, *L. acidophilus-odontolyticus* is found to develop normally as a raised glistening white, round, smooth-edged colony of even textures. A count is then made, which is based on either 1 cc. of saliva or a fraction thereof.

Detailed procedures are given for the preparation of the media and the anaerobic apparatus employed.

Rodriguez, F. E., 1931. QUANTITATIVE INCIDENCE OF LACTOBACILLUS ACIDOPHILUS IN THE ORAL CAVITY AS A PRESUMPTIVE INDEX OF SUSCEPTIBILITY TO DENTAL CARIES. Jour. Amer. dental Assoc., 18 (11): 2118-2135.

The quantitative difference in the incidence of *Lactobacillus acidophilus* in the saliva were studied in persons of various ages before and after the employment of certain clinical procedures. Under the influence of various hygienic, operative, and dietary measures, counts of *L. acidophilus* were reduced from 80,000,000 colonies per cc. to counts between zero and only a few thousand colonies. The author states that the fluctuations in counts can occur in the same person at different times, even in the absence of

lesions. In the clinically noncarious mouths there is a constantly rising and falling tide of the organism, but the incidence is always maintained within the bounds of safety. He concludes that a mechanism of defense exists in the mouth, which is capable of effectively dealing with slight contamination, providing the bacterial incidence does not exceed certain limits.

Roeder, H., 1907. EIN EXPERIMENTELLER BEITRAG ZU PATHOGENESE DER SALIVATION BIE VERDAUUNGSKRANKHEITEN [An experimental contribution to the pathogenesis of salivation in digestive diseases]. Arch. Kinderheilk, 47 (1-3): 60-68.

Experiments were carried out to test the excessive salivation in diseases of the digestive system. After mechanical, chemical, and electrical stimulation of the various segments of the digestive tract of the fistulated dog, the following became evident: the excessive salivation incident to digestive diseases is neither conditioned by a reflex, nor by a functional disorder within the salivary gland but by an increasing reflux of liquids flowing from the stomach to the oral cavity. The increase of the parietal blood flow from the stomach through the esophagus, reaches the oral cavity affecting the centripetal nerves of the salivary glands.

Roger, H., 1907. ACTION DE LA SALIVE CHAUFFÉE [Action of heated saliva]. Compt. rend. de la Soc. de Biol. (Paris), 62 (16): 833-834.

Centrifuged, human saliva lost its amylolytic power upon heating for 10-15 minutes at 85°-100°C. Addition of a small amount of fresh saliva restored some power to digest starch.

Roger, H., 1907a. ACTION DU SUC GASTRIQUE SUR LA SALIVE [Action of gastric juice on saliva]. Compt. rend. de la Soc. de Biol. (Paris), 62 (19): 1021-1023.

Addition of gastric juice rapidly destroyed the amylolytic action of saliva. Neutralization of the mixture did not result in recovery of this action, but addition of a trace of fresh saliva to the neutral mixture resulted in abundant saccharification.

Roger, H., and L. G. Simon, 1907b. ACTION SYNERGETIQUE DE LA SALIVE ET DU SUC PANCRÉATIQUE [Synergetic action of saliva and pancreatic juice]. Compt. rend. de la Soc. de Biol. (Paris), 62 (20): 1070-1072.

Human saliva treated with dilute (0.25%) HCl lost its amylolytic power. After the mixture was made alkaline, addition of small amounts of pancreatic juice restored some power of the saliva to digest starch.

Roger, H., 1908. INFLUENCE DES OEUF DE POULE SUR LE POUVOIR SACCHARIFIANT DE LA SALIVE [The effect of chicken eggs on the saccharifying power of saliva]. Compt. rend. de la Soc. de Biol. (Paris), 64 (1): 16-17.

Tests with 1.5% solution of starch and human saliva constantly showed a greater conversion of starch to sugar if some white or yolk of a hen's egg were added to the test tubes. Tubes containing yolk showed a greater quantity of sugar than those containing the white. These tests repeated with bread as the source of the starch gave similar results.

Roger, H., 1908a. SUR LE RÔLE DES PHOSPHATES DANS LA SACCHARIFICATION SALIVAIRE [On the role of phosphates in salivary saccharification]. Compt. rend. de la Soc. de Biol. (Paris), 65 (30): 374-375.

Human saliva lost its amylolytic power when the salivary phosphates had been precipitated with uranium acetate. Recovery took place after addition of sodium phosphate.

Rogers, H. J., 1948. BACTERIAL HYDROLYSIS AND UTILIZATION OF POLYSACCHARIDE-LIKE SUBSTANCES ("MUCIN") IN SALIVA. Nature 161 (4099): 815-816.

Tests were made of the amount of glucosamine present in 5 samples of raw, unstimulated human saliva after various periods of incubation at 37°C. The rate of disappearance of glucosamine, estimated after acid hydrolysis of the saliva, was found to be paralleled by that of both total sugar and reducing sugar. Utilization of the glucosamine was completely inhibited by bactericidal substances (phenol, toluene, thymol, penicillin) or heating at 100° for 5 minutes; 1% glucose or maltose, but not powdered solid starch, caused partial inhibition. A substance accumulated in some samples, in the presence of the bactericides, which appeared chemically similar to N-acetyl-glucosamine and was diffusible through cellophane. Its liberation was due to enzymes associated with the cellular material present in the saliva and not to salivary enzymes.

Rogosa, Morrison, Joyce A. Mitchell, and Robert J. Fitzgerald, 1950. FREQUENCY DISTRIBUTION OF LACTOBACILLUS TYPES IN THE SALIVAS OF CHILDREN. Jour. dental Res., 29 (5): 658-659.

"Ninety-nine saliva samples, which were obtained from children in the first through the sixth grades, were plated on tomato juice agar (pH5), and 360 representative isolates of lactobacilli were replated until pure cultures were secured. All gram-positive, catalase-negative rods producing acidity from sugars were accepted as lactobacilli. Organisms producing gas (CO₂) were designated as heterofermentative as distinguished from the non-gas producing homofermentative lactobacilli. For further subdivision, fermentation tests were performed with 20 carbohydrates. Total acidities in milk, limits of temperature for growth, and the vitamin requirements of the organisms were determined. Based on these tests it was found that the frequency distribution of the total sample was: *L. casei*, 38.05 percent; *L. acidophilus*, 10.57 percent; *L. plantarum*, 2.54 percent; new species (homofermentative), 2.33 percent; miscellaneous unidentifiable (homofermentative), 0.85 percent; *L. fermenti*, 22.41 percent; *L. brevis*, type I, 5.07 percent; *L. brevis*, type II, 4.86 percent; new species (heterofermentative), 10.78 percent; and miscellaneous unidentifiable (heterofermentative), 2.54 percent. Of this total sample, 45 percent were heterofermentative and 55 percent homofermentative types. In addition, 114 strains of lactobacilli were isolated from saliva samples plated on tomato juice agar containing one unit of penicillin per ml. The strains in this group comprised 85 percent heterofermentative and 15 percent homofermentative lactobacilli." (Complete paper.)

Rogosa, Morrison, Joyce A. Mitchell, and Ralph F. Wiseman, 1951. A SELECTIVE MEDIUM FOR THE ISOLATION AND ENUMERATION OF ORAL AND FECAL LACTOBACILLI. *Jour. Bacteriol.*, 62 (1): 132-133.

A selective medium for the isolation of oral lactobacilli is described. The medium is composed of 10 g. trypticase, 5 g. yeast extract, 6 g. KH_2PO_4 , 2 g. ammonium citrate, 5 ml. salt solution (salt solution = 11.5 g. $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$, 2.4 g. $\text{MnSO}_4 \cdot 2\text{H}_2\text{O}$ or 2.8 g. $\text{MnSO}_4 \cdot 4\text{H}_2\text{O}$, 0.68 g. $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$, to 100 ml. with distilled water), 20 g. glucose, 1 g. sodium oleate, 25 g. sodium acetate hydrate, 1.32 ml. acetic acid, 15 g. agar, to 1 liter with distilled water. The final pH is 5.4.

Rogosa, Morrison, J. A. Mitchell, and R. F. Wiseman, 1951a. A SELECTIVE MEDIUM FOR THE ISOLATION AND ENUMERATION OF ORAL LACTOBACILLI. *Jour. dent. Res.*, 30 (5): 682-689.

A description is given of the composition and preparation of a selective medium for the isolation and counting of oral lactobacilli. A comparison was made of the effectiveness of the new SL medium and of Hadley's tomato juice (TJ) agar, using 122 human salivary samples and 156 oral hamster samples. With the exception of greatly reduced numbers of yeasts, the SL agar showed a high degree of selectivity for lactobacilli; micrococci, staphylococci, streptococci, molds, spore-forming bacteria and gram-negative rods were completely eliminated.

Rogosa, Morrison, and Ralph F. Wiseman, 1952. A COLORIMETRIC TEST FOR THE RELATIVE ABUNDANCE AND ACIDOGENIC POTENTIAL OF LACTOBACILLI IN SALIVA. *Jour. dental Res.*, 31 (4): 470.

"Based on the selective lactobacillus medium (SL Agar), of Rogosa, Mitchell, and Wiseman (*J. D. Res.* 30: 682, 1951), a technique was developed for the determination of (1) the relative abundance of lactobacilli in saliva, or (2) their acidogenic potential, or (3) both. The foregoing medium was modified by the addition of 0.05 percent 1 (+) arabinose; 0.004 percent alizarine red S (sodium alizarine sulfonate); and also by the reduction of the agar concentration to 0.2 percent. The medium was heated minimally to dissolve the agar and was dispensed in 5 ml. quantities into 16 X 150 mm. tubes. Further heating was disadvantageous, since the indicator exhibited undesirable change. The tests were performed repeatedly during 1 year on the salivas from 150 individuals. One loopful of saliva was inoculated into each tube and incubated at 37°C. for 48 hours. The color changes were read after 24 and 48 hours. A change from purple to yellow was considered positive. Based on the rate and extent of color change, a scoring system from 1 to 10 (1 being negative and 10 most positive) was correlated with the lactobacillus counts from SL agar which were scored 0-1000= 1; 1000-10,000= 2; 10,000-100,000= 3; 100,000-1,000,000= 4; >1,000,000= 5. Correlation of the results between the 2 procedures was +0.9988 with a scatter, or standard error of estimate, of 0.0874." (Complete paper.)

Rogosa, Morrison, R. F. Wiseman, J. A. Mitchell, M. N. Disraely, and A. J. Beaman, 1953. SPECIES DIFFERENTIATION OF ORAL LACTOBACILLI FROM MAN INCLUDING DESCRIPTIONS OF LACTOBACILLUS

SALIVARIUS NOV SPEC AND LACTOBACILLUS CELLOBIOSUS NOV SPEC. *Jour. Bacteriol.*, 65 (6): 681-699.

A review of the literature on the taxonomic status of the oral lactobacilli is presented. A study was made of 500 lactobacilli isolated from the paraffin-stimulated saliva of 130 children in the elementary school grades 1 to 7. The cultural, morphological, and biochemical properties of the isolates were studied. Results indicated that the oral lactobacilli comprised a spectrum of species of which *Lactobacillus acidophilus* was only one member. In all cases *L. casei* and *L. fermenti* constituted the bulk of the strains. The percentages of the isolates and percentages of the samples in which they appeared were: *L. casei*, 39.2 and 59.2; *L. acidophilus*, 11 and 21.5; *L. salivarius nov spec*, 2.2 and 6.2; *L. plantarum*, 2.0 and 2.3; *L. arabinosus*, 1.2 and 3.1; homofermentative unidentifiable species, 0.4 and 1.5; *L. fermenti*, 30.8 and 45.4; *L. buchneri*, 5.0 and 10.0; *L. brevis*, 6.2 and 16.9; *L. cellobiosus nov spec*, 1.2 and 1.5; and heterofermentative unidentifiable strains, 0.8 and 1.5. At least 2 species were present simultaneously in 60 percent of the samples and 3 species were present in 23 percent. The characteristics of the cited species are described and the ecological relationships of the oral lactobacilli are discussed.

Rogosa, M., E. Johansen, and M. N. Disraely, with A. J. Beaman, 1957. THE RELATION OF STREPTOCOCCI, LACTOBACILLI, AND THE GENERAL ORAL AND FECAL FLORA TO THE PROGRESSION OF DENTAL CARIES IN THE HAMSTER. *Jour. dent. Res.*, 36 (5): 695-708.

A technic for repeated bacteriologic samplings of hamster saliva and correlative dental examinations has been described. No positive relationship was found between salivary streptococci and dental caries in either male or female hamsters. No correlation was observed between salivary lactobacilli and dental caries in females. In male hamsters a positive relationship was noted between lactobacilli and dental caries, but only after very extensive development of lesions. The final mean caries scores of males and females in this study were not significantly different. The ecologic relations of the streptococci and lactobacilli were widely different in the mouth as compared to the feces. Microscopic examination of oral and fecal smears indicated that the streptococci and lactobacilli were a relatively small part of the total flora and that a great percentage of the organisms, such as fusiforms, bacteriodes, large coccal organisms other than streptococci, etc., have not been cultured. (Author's summary)

Romaña, C., 1939. ACTION ANTICOAGULANTE DE LA SALIVE DU VAMPIRE DESMODUS ROTUNDUS ROTUNDUS (ET. GEOF.) [Anticoagulant action of the saliva of the vampire bat, *Desmodus rotundus rotundus* (Et. Geof.)]. *Bull. Soc. Pathol. exotique*, 32 (4): 399-403.

The anticoagulant action of vampire bat saliva was studied in vivo and in vitro experiments. Tests in the rabbit showed its blood coagulation time to increase from a normal of 2 min, 15 sec. to 8 minutes at the site of a bite and 30-minute feeding period by the bat. In vitro tests with rabbit, horse, and human blood gave similar

results. The anticoagulant property of the bat's saliva was found to be weak and variable.

Römer, , 1927. SPEICHELDRÜSEN UND INNERE SEKRETION [Salivary glands and internal secretion]. Klin. Wochenschr., 6 (23): 1118.

Cases of parotid swelling as a secondary appearance in pathological cases are described. Clinical and pharmacological examinations of the patients suggested the influence of a dysfunction of the autonomic nervous system. Other cases were mentioned in the discussion which followed. Haselhorst discussed post-operative disturbances of salivary secretion. The author suggested the possibility of influence of the buccinator muscle on the emptying of the salivary gland. In the cases encountered there was always an initial hypersecretion which suddenly dried up.

Romey, A., and J. Fricker, 1935. ABSENCE DE POUVOIR ANTAGONISTE MICROBIEN DANS LA SALIVE [Absence of microbial antagonistic power in saliva]. Compt. rend. Soc. Biol. (Paris), 120; 887-890.

The salivas of 20 persons were examined for antimicrobial properties. All of the salivas contained streptococci, staphylococci, coli-bacteria, and enterococci. Pure saliva, however, was not suitable for the culture of these organisms; the addition of a small amount of peptone bouillon permitted a culture to be made. These findings seem to be in contradiction with those of Dold and Weigmann [Zeitschr. f. Hyg., 117: 2. 1934o].

Rona, P., and J. Hefter, 1930. ÜBER DIE GLEICHZEITIGE WIRKUNG VON SPEICHEL-, PANKREAS- UND MALZAMYLAUSE AUF STÄRKE [The simultaneous action of saliva, pancrease, and malt amylase on starches]. Biochem. Zeitschr., 217 (1-3): 113-124.

Manometric analyses were conducted to study the decomposition of starches to glucose effected by various enzymes. In experiments carried out with salivary amylase, no increase in pressure was seen which would be indicative of the presence of glucose originating from the decomposition of starches. Similar results were reached when maltose, and maltose and enzyme were added to pancreatic amylase. Tests using combinations of salivary and pancreatic amylase, salivary and malt amylase, as well as pancreatic and malt amylase failed to show manometric evidence of starch hydrolysis.

Rosebury, Theodor, 1930. STUDIES OF THE ACIDURIC BACTERIA OF THE MOUTH IN RELATION TO SUSCEPTIBILITY AND IMMUNITY TO DENTAL CARIES. Jour. dental Res., 10 (3): 403-404.

The salivas of 3 persons (non-susceptible to caries) and of 3 normal dogs were studied in relation to 5 strains of aciduric bacilli isolated from carious teeth. Two human salivas were completely negative for agglutination in all tests; slight agglutination was obtained with the third sample but only when resting saliva was used. Similar results were obtained with the dog samples (2 neg., 1 pos.).

When saliva-serum mixtures of dogs were tested for growth-inhibitory power, results were negative. One dog's mouth consistently yielded cultures of aciduric bacilli on 5 different days; the dog's mouth showed two "developmental" enamel pits and

an area with exposed dentin, all completely free from carious change. No other dogs yielded aciduric bacilli.

Another investigation, in progress at the time the paper was written, disclosed that each of 40 albino rats examined had aciduric bacteria (*Lactobacillus acidophilus* type) as a normal inhabitant of the mouth. The author states that this lends evidence to support the conclusion that "immunity and susceptibility to dental caries do not depend, respectively, on the oral presence or absence of an inhibiting factor against organisms of the *L. acidophilus* type".

Rosebury, Theodor, 1937. ACIDURIC FLORA OF SALIVA OF KUSKOKWIM ESKIMOS, WITH AND WITHOUT DENTAL CARIES. Jour. dental Res., 16 (4): 306-307.

The aciduric flora of the salivas from 106 Eskimos was cultured on tomato agar (pH 5.0) and was studied for relation to dental caries. Lactobacilli occurred in 80.6% of the carious individuals (29 of 36 persons), 13.6% of the caries-free (6 of 44 persons), and 42.3% of the doubtful cases (11 of 26 persons); the lactobacilli averaged 122,350 per cc. saliva among the carious, 2,570 among the caries-free, and 34,290 among the doubtful subjects. In 13 cases (12 caries and 1 doubtful), lactobacilli appeared either in pure cultures or with yeasts only. Yeasts occurred in 30.5% of the caries cases (11), 2.3% of the caries-free cases (1), and 23.1% of the doubtful (6).

No correlation was noted between any other organisms in media used and caries incidence.

Rosebury, Theodor, and L. M. Waugh, 1939. DENTAL CARIES AMONG ESKIMOS OF THE KUSKOKWIM AREA OF ALASKA. I. CLINICAL AND BACTERIOLOGIC FINDINGS. Amer. Jour. Dis. Child., 57 (4): 871-893.

A clinical study was made of the incidence of dental caries among 124 native Eskimos of the Kuskokwim area of Alaska. Of these, the paraffin-stimulated saliva of 106 subjects was used in a bacteriological analysis of the aciduric flora. The subjects were classified into 3 groups: those having active caries (36); those having doubtful caries (26); and those completely free from caries (44). Of the subjects with caries, 80.6 percent were found to have lactobacilli present with an average of 122,350 lactobacilli per cc. of saliva; 42.3 percent of those with doubtful caries had lactobacilli present with an average of 34,290 per cc.; 13.6 percent of the subjects free from caries exhibited lactobacilli with an average of 2,570 per cc. Yeasts were found in 30.5 percent of the subjects with caries, in 23.1 percent with doubtful caries, and in 2.3 percent of those free from caries.

Rosen, S., M. A. Benarde, F. W. Fabian, H. R. Hunt, and C. A. Hoppert, 1957. SEVERAL PROPERTIES OF SALIVA FROM HUNT-HOPPERT CARIES-RESISTANT AND CARIES-SUSCEPTIBLE RATS. Jour. dent. Res., 36 (1): 87-91.

Determinations were made of the untreated salivas of caries-resistant and caries-susceptible rats of 4 different age groups, with regard to pH, amylase activity, refractive index, agglutinin titer, as well as for antagonistic effect against oral lactobacilli. Determinations were also made of the specific gravity, relative viscosity and

surface tension, using Seitz-filtered samples of the salivas. A slight tendency was found for a higher relative viscosity of salivas among the caries-resistant rats than among the caries-susceptible. No clear differences were found with respect to age group or other salivary properties.

Rosen, S., L. M. Sreebny, C. A. Hoppert, H. R. Hunt, and E. Bachem, 1958. STUDIES ON SALIVARIADENECTOMIZED HUNT-HOPPERT CARIES-RESISTANT AND CARIES-SUSCEPTIBLE RATS. I. EFFECT OF SALIVARIADENECTOMY ON DENTAL CARIES AND SEVERAL GROUPS OF THE ORAL MICROFLORA. *Jour. Dent. Res.*, 37 (5): 824-831.

Tests of 138 caries susceptible and resistant rats on a cariogenic diet showed the absence of secretion from the major salivary glands in 55 experimental animals to be accompanied by a significant increase in lactobacilli but not in total bacterial flora, coliforms, or streptococci, in comparison to the 83 intact controls. Salivariadenectomy caused an increase in caries in 35 resistant rats but not in the 20 susceptible animals in comparison to the intact controls.

Rosenblueth, Arturo, 1932. THE CHEMICAL MEDIATION OF AUTONOMIC NERVOUS IMPULSES AS EVIDENCED BY SUMMATION OF RESPONSES. *Amer. Jour. Physiol.*, 102 (1): 12-38.

A quantitative study was made of submaxillary gland responses in the dog to electrical stimuli of supramaximal intensities at frequencies varying from 0.8 to 25 shocks per second.

Application of such stimuli to the isolated chorda tympani in a Dial-anesthetized dog elicited a flow of saliva which varied from 4 drops to 43 drops with increase in shock frequency; with increase in frequency of stimuli the response was earlier, the after-effect (disappearance of flow) longer. The relations between the stimulus frequency and the magnitude of the responses, in this experiment as well as others on various organs in the cat, appear to obey a general hyperbolic law. A chemical hypothesis is advanced in which a chemical mediator liberated by the nervous impulse combines with some substance in the effector, the response being proportional to the concentration of the combination thus formed. Free mediator substance is considered to be destroyed locally (hence relaxation) at a limited rate permitting possible diffusion to other structures when the concentration is excessive. It is concluded that the effects of spatial summation on responses of the various organs are small when compared with those obtained by temporal summation.

Rosenthal, S. Leonard, Wallace M. McNabb, and Raymond C. Snyder, 1939m. THE IDENTITY OF AN ANTIBACTERIAL FACTOR IN THE SALIVA OF CERTAIN MAMMALIA. *Jour. Amer. dental Assoc.*, 26 (11): 1859-1862.

Bright- and dark-field smears were made from the gingivae of certain mammalia: 50 dogs, 8 cats, 28 pigs, 2 horses, 1 rabbit, 1 guinea pig, 1 rat, 1 rhinoceros, 1 hippopotamus, 2 elephants, 2 lion cubs, 1 baboon, 1 green monkey, and 2 young chimpanzees. In general, the smears showed a low bacterial count for these animals as compared with that of man. From this evidence, it

was felt that the mouths of healthy animals contained an antibacterial substance.

In a series of experiments attempting to identify such an antibacterial substance, saliva was obtained from 25 dogs, 4 cats, 1 green monkey, 2 horses, and 1 rhinoceros. In most cases salivation was induced by placing a few drops of a bitter substance (usually atropine sulfate) on the tongue; in the horses, by subcutaneous injection of choline chloride; and in the rhinoceros by holding an apple over its head. The pH of all these saliva samples ranged from 8.4 to 8.6 (Beckman pH meter). Each sample was subjected to a motility test as follows: a certain amount of saliva was brought in contact under a dark-field microscope with an equal quantity of saliva from a patient with Vincent's infection. The antibacterial properties of the animals' saliva were determined by measuring the time which elapsed from the moment of contact of the saliva solution to the cessation of movements of spirochetes, vibrios, and motile bacilli. Contact with all normal animal saliva caused immediate loss of mobility among human oral spirochetes and vibrios; most of the motile bacilli lost their motility in five minutes. No effect was noted on the non-motile flora.

The antibacterial properties of canine saliva of diseased animals was studied in one dog with black tongue, and in 6 dogs with oral infection similar to Vincent's infection in man. The saliva of these animals had no effect on the human oral flora; the saliva from normal animals instantly destroyed the motility of the organisms from the sick dogs.

A quantitative analysis of the inorganic constituents of the saliva of several normal dogs showed the following to be present: phosphate, chloride, calcium, magnesium and possibly potassium, ammonia, sodium chloride, carbonate as sodium carbonate and bicarbonate. It is concluded that sodium carbonate, present in the saliva of normal animals but absent in human saliva, inhibits the motile oral flora of man, but has little effect on the non-motile bacteria. This carbonate may disappear from the saliva of individual animals, predisposing them to fusospirochetal infection. Only laboratory animals, whose saliva is normally free from the carbonate, are considered suitable for experiments on Vincent's infection. It is suggested that solutions of sodium carbonate are of value in the treatment of Vincent's infection.

Rosenthal, S. Leonard, and Gordon R. Winter, 1950. COMPARATIVE STUDIES OF STREPTOMYCIN AND PENICILLIN IN THE TREATMENT OF INFECTIONS OF THE ORAL MUCOSA. *Jour. dental Res.*, 29 (2): 237-239.

The effects of penicillin and streptomycin on oral infection were studied in vivo and in vitro.

In in vitro tests, equal parts of penicillin solution (penicillin G, 20,000 units per cc. distilled water) and saliva were mixed and let stand for 72 hours. Following clinical application, gingival irritation occurred in two cases; the solution was therefore discarded. A solution of 10,000 units penicillin per cc. inhibited growth of Vincent's organisms in the culture medium. The time for loss of motility varied, depending upon the amount of debris present.

Streptomycin (100 mg./cc. distilled water), similarly tested, penetrated the debris rapidly. Motility stopped immediately; no growth occurred in culture media.

When the penicillin and streptomycin solutions were applied to streak plates, inhibition areas indicated that penicillin was effective for 24 hours, streptomycin for 7 days.

In *in vivo* tests, saliva samples alone and saliva mixed with either antibiotic were injected subcutaneously into guinea pigs. Abscesses formed at the site of injection of the untreated saliva; no change occurred at the site of the injection of the antibiotic-saliva mixtures.

In testing for effectiveness in clinical use, streptomycin and penicillin-saliva mixtures were applied to the gingivae of persons with Vincent's infection or pericoronitis. Dark-field examinations were made; results are given. In general, relief followed penicillin application after 4 to 12 hours; streptomycin application, after 2 to 6 hours.

The average counts of microorganisms occurring 15, 30 and 60 minutes and 24 hours after penicillin and streptomycin therapy are presented (cf. Table I).

Roskin, Miriam, 1928. MINERAL CONTENT OF SALIVA OF CHILDREN WITH ARRESTED DENTAL CARIES. *Proc. Soc. exper. Biol. Med.*, 25 (6): 465-466.

The pH and the calcium, phosphorus, and chloride contents of the salivas of 2 groups of children (one composed of 17 diabetics with arrested caries and the other of 13 non-diabetics with marked caries and soft teeth) were determined in an effort to establish a relationship between the mineral content of saliva and caries activity. Mean values were as follows (non-diabetics in parentheses): calcium, 5.7 mg./100 cc. (5.5); phosphorus, 12.1 mg./100 cc. (11.5); chlorine, 69.6 mg./100 cc. (55.0); and pH, 6.8 (6.9). No significant differences were observed.

Ross, Victor, F. Krasnow, and J. Samet, 1927. AGGLUTININS IN SERUM AND SALIVA OF RABBITS INOCULATED WITH *B. ACIDOPHILUS*. *Jour. dent. Res.*, 7 (3): 337-344.

An investigation was made of the presence of *B. acidophilus* [*Lactobacillus acidophilus*] agglutinins in the sera and saliva of rabbits. Two strains (L and D₃) of *B. acidophilus* were carried through 150 parallel transplants in whey broth, and suspensions of the bacteria were standardized against known erythrocyte counts and made up in three dilutions: 1 X 10⁸, 2 X 10⁸, and 1 X 10⁹ per cc. Every test rabbit received 0.8-1.0 cc. inoculations of each of the three preparations. One month after the injections, heart blood and pilocarpine-stimulated saliva were recovered and each sample was tested for agglutinins. The bacterial suspensions for the agglutination tests were diluted to contain 2.5 x 10⁹ organisms per cc. and serum serial dilution ranged from 1:4, e.g., 1 part serum to 4 parts 0.9% NaCl, to 1:256; salivary samples were made up in like dilutions.

The agglutination tests revealed various amounts of agglutinins in the sera of 14 of the 18 rabbits studied; 7 of the 14 rabbits contained agglutinins in their saliva, although in lesser titers. Cross agglutinins for the two strains were also present.

Rossert, Walter A., and James M. Dunning, 1945. SALIVARY DILUTION OF 1:1000 SODIUM FLUORIDE SOLUTION USED AS A MOUTHWASH. *Jour. dent. Res.*, 24 (6): 311-314.

A study of the rate of dilution of 25 cc. of a 1:1000 sodium fluoride solution held in the mouth showed a change from 1:1000 (0.1%) to 1:1032 (0.09609%) in 2 minutes; from 1:1000 (0.1%) dilution to 1:1052 (0.0951%) in 5 minutes. 9% of the cases were excluded due to a volume loss; it is believed that possibly 6% of the dose was swallowed.

Further investigations revealed that a greater volume increase (salivary flow) occurred in males than in females and, in both sexes, between the ages of 50 and 59.

Rossi, P., and Daubard, 1939. TENEUR EN URÉE DE LA SALIVE ET DU SERUM SANGUIN DU CHEVAL APRÈS INJECTION DE PILOCARPINE [Urea content of saliva and blood serum in the horse after pilocarpine injection]. *Compt. rend. Soc. Biol. (Paris)*, 130: 1439-1441.

The urea content of saliva was studied in the parotid secretion of the horse, stimulated by subcutaneous injections of 5 to 10 cg. pilocarpine, and compared to the urea content of the blood. The saliva was acidified by trichloroacetic acid immediately after collection; its urea content was measured by the sodium hypobromite method in d'Ambard and Hallion's ureometer, the ammonium nitrogen content by the Delauney. Tests were made in 10 horses of approximately 400 kg. each.

The salivary urea content which is regularly inferior to that of the blood varies from 0.140 to 0.307 gm., predominantly around 0.250 gm., being usually higher in the first, lower in the second, and again higher in the last salivary sample. Contrary to human saliva, different salivary samples in the horse contained only traces of ammonium nitrogen averaging less than 1 gm.; the maximum titer found was 0.02 gm., the minimum 0.025 gm.

Rossi, Paul, and Daubard, 1939a. TENEUR EN URÉE DE LA SALIVE ET DU SERUM SANGUIN DU CHEVAL, APRÈS INJECTIONS D'ARECOLINE. [Urea content of the saliva and blood serum in the horse after injection of arecoline]. *Compt. rend. Soc. Biol. (Paris)*, 130: 1586-1587.

The effects on salivary and blood-serum urea levels, produced by 5 cg. subcutaneous injections in each of five 400 kg. horses, were in accord with those produced by injection of pilocarpine (Rossi, 1939m). The salivary content of urea, uniformly inferior to that of the blood serum, decreased as salivary flow reached its peak and then returned to its former level toward the end of salivation. No increase in ammonia nitrogen was apparent in the saliva of the horse during the first hours after its secretion.

Rovelstad, G. H., and J. H. Geller, 1958. DENTAL-CARIES EXPERIENCE AND THE ORAL ENVIRONMENT. *Jour. dent. Res.*, 37 (1): 75.

A group of young male adults (A), free from evidence of dental-caries experience at the time of entering the Receiving Center, have been under study since early 1956. A series of bacteriologic and biochemical tests have been conducted on the

saliva of these young men for the purpose of determining oral characteristics. Two other groups were also selected and subjected to the same tests: one (B) a group of naval personnel of average dental conditions and the other (C) a group of naval recruits having rampant dental-caries experience prior to time of entrance. Three samples of saliva were taken from each subject and the following tests were conducted on each sample: lactobacillus count, Snyder test, desoxycholate agar plate count, Chapman's medium plate count, litmus milk test, nutrient broth turbidity test, optical density of nondialyzable saliva at 280 $m\mu$ wave length (protein), optical density of dialyzable saliva at 288 $m\mu$ wave length (uric acid), optical density of 1 N citrate solution of acetone precipitate of supernatant at 263 $m\mu$ wave length (nucleoprotein), optical density of saliva supernatant at 405 $m\mu$ wave length (blood), dissolved solids in supernatant sediment volume, and sediment decomposition. A significant relationship to the dental caries experience of the selected groups occurred in the Snyder test, lactobacillus test, litmus milk, desoxycholate agar count, optical density at 280 $m\mu$ dialyzable saliva, optical density at 405 $m\mu$, and amount of sediment decomposition of saliva. (Author's abstract)

Rovelstad, G. H., J. H. Geller, and A. H. Cohen, 1958a. THE HYALURONIDASE ACTIVITY OF SALIVA. I. THE DETERMINATION OF CHARACTERISTICS OF HYALURONIDASE ACTIVITY IN YOUNG MALE ADULTS. Jour. dent. Res., 37 (1): 107-113.

A modified viscosity-reduction technique (Lisanti, 1950m.) was developed to determine the hyaluronidase activity of paraffin-stimulated saliva, obtained from a number of young adult males. A 2.5 ml. portion of supernatant saliva, from 15 ml. of a salivary sample centrifuged at 1500 G. for 10 minutes at room temperature, is mixed with 2.5 ml. of hyaluronic acid substrate in a viscosimeter maintained at 37°C.; the difference in seconds of flow time, between the immediate reading and another 45 minutes later, is used as an index of salivary hyaluronidase activity. The tabulated and analyzed results of tests, using saliva collected at different periods of one day as well as on different days, show variation in hyaluronidase activity. The high, medium, or low range activity will remain relatively constant, however, for the individual or the group over a period of weeks; the most reproducible results for salivary hyaluronidase activity can be obtained by using samples of fasting saliva collected at the same time of day under the same circumstances. Tests of fasting saliva collected from each of 77 subjects at 11 A.M. once a week for 3 weeks showed an average hyaluronidase activity of 10.5 seconds, with a range of 1.5 to 18.4 seconds and a standard deviation of 3.16.

Rovelstad, G. H., J. H. Geller, and A. H. Cohen, 1958b. THE HYALURONIDASE ACTIVITY OF SALIVA. II. THE RELATIONSHIP OF HYALURONIDASE ACTIVITY ON DENTAL CARIES EXPERIENCE, GINGIVITIS, AND ORAL HYGIENE IN YOUNG MALE ADULTS. Jour. dent. Res., 37 (1): 114-118.

Three 20 ml. samples of paraffin-stimulated saliva were collected weekly over a 3-week period from 1049 naval recruits at 11 AM after 5 hours

of supervised fasting. Hyaluronidase activity was determined by means of the viscosity-reduction technique (Rovelstad et al, 1958m.). The average hyaluronidase activity of the entire group was found to be 10.8 seconds decrease in the viscosity of the saliva-substrate mixture; the range was 0.5 to 24.9 seconds and the standard deviation, 4.1 seconds. No significant variation from this average value was found with respect to DMF teeth, carious teeth, or carious surfaces. Evaluation of salivary hyaluronidase activity in relation to gingivitis showed average activity in a severe gingivitis group to be 13.1 seconds, while that of a gingivitis-free group was 9.8 seconds. Hyaluronidase activity in a group showing poor oral hygiene averaged 12.3 seconds, compared to 10.4 seconds among subjects showing good oral hygiene. The use of color photographs to diagnose and classify gingivitis and oral hygiene is described.

Rovelstad, G. H., J. H. Geller, and A. H. Cohen, 1958c. CARIES-SUSCEPTIBILITY TESTS, HYALURONIDASE ACTIVITY OF SALIVA AND DENTAL CARIES EXPERIENCE. Jour. dent. Res., 37 (2): 306-311.

Determinations were made of the rate of salivation, pH, acid-neutralizing and acid-producing abilities, lactobacillus counts, and hyaluronidase activity of the paraffin-stimulated salivas of 1049 young naval recruits. Saliva samples were collected on 3 successive days one week apart at 11 A.M. after 5 hours of supervised fasting. Median results are analyzed for selected and random groups of subjects with regard to caries experience. Results show that increases in the lactobacillus count and in the acid-producing ability of saliva are directly related to increase in dental caries experience. Inverse relationships were found of both the rate of flow and the acid-neutralizing ability of saliva to caries experience in groups. No relationships were found between the pH or the hyaluronidase activity to caries experience in groups.

Rovelstad, G. H., J. H. Geller, and A. H. Cohen, 1958d. THE HYALURONIDASE ACTIVITY OF SALIVA. VI. EFFECT OF ANTIBIOTIC THERAPY ON HYALURONIDASE ACTIVITY OF SALIVA. Jour. dent. Res., 37 (3): 453-457.

The effect of penicillin therapy upon the hyaluronidase activity of saliva was studied in two groups of young adult males. Hyaluronidase determinations (Rovelstad et al, 1958m) were made of paraffin-stimulated saliva collected at 11 A.M. after 5 hours of supervised fasting. The average hyaluronidase activity for the first group of 56 subjects, 4 days prior to intramuscular injection of 600,000 or 900,000 units of a long-acting penicillin, was 9.8 seconds; throat culture surveys showed a 13% incidence of Group A streptococci in the regiment from which the subjects were selected; streptococcal upper respiratory disease rate was 18 cases per 1000 in this larger group. Three days after the injection, the hyaluronidase activity dropped to 7.6 seconds, incidence of Group A streptococci dropped to 2% and the disease rate to 1.5 cases/1000/week. Ten days after the injection the hyaluronidase returned to 10.3 seconds, Group A incidence in the regiment rose to 15% and the rate of upper respiratory infection to 20.0 cases/1000/week. The hyaluronidase activity changes were

more marked in the subjects receiving the larger dosage of penicillin. The average hyaluronidase activity in the second group of 49 similar subjects from another regiment, 4 days prior to daily oral administration of penicillin for 31 days, was 11.3 seconds; regimental incidence of Group A streptococci was 14%, and the disease rate, 10.3 cases/1000/week. Ten days after receiving 500,000 units daily, the average hyaluronidase activity dropped to 8.0 seconds, regimental incidence of Group A streptococci dropped to 2%, and the disease rate to 5.0 cases. Oral ingestion of 250,000 units daily during the succeeding 21 days resulted in a further drop in average hyaluronidase activity to 6.0 seconds, Group A incidence to 0.5%, and the disease rate to 0.6 cases.

Rowlands, William, 1888. PERMANENT SUPPRESSION OF THE SALIVARY SECRETION. *Lancet* (London), 1 (3359): 104.

A report is given of a case in which a 60 year old woman has suffered from the absence of saliva for 10 years. The condition followed a severe nervous shock.

Rozhanskii, N., 1935. LE PROBLÈME DES CENTRES ALIMENTAIRES ET DÉFENSIFS. [The problem of the food and defensive centers]. *Fiziol. Zhur. SSSR*, 19 (1): 315-321.

The role of the unconditioned salivary secretion in the dog as an indicator of the food and defense reflexes is discussed. The coefficient P/S, representing the relation of the parotid secretion to that of the submaxillary and sublingual glands, is stated to be very constant for each type of stimulant in each individual dog. For stimulants eliciting a defense reaction this coefficient is, as a rule, above the unit; for food stimulants it is below the unit. In man, this constant relation does not exist, and the coefficient cannot be used as an indicator for food or defensive reflexes.

Rubel', V. M., and I. M. Khasen, 1948. IZUCHENIE DEIATEL'NOSTI PISHCHEVARITEL'NYKH ZHELEZ V VYSOKOGORNYKH USLOVIIĀKH [Study of the activity of digestive glands in high mountains]. IN VLIĀNIE PONIZHENNOGO BAROMETRICHESSKOGO DĀVLENIĀ NA PROTSESSY PISHCHEVARENIIĀ. [The influence of lowered atmospheric pressure on the processes of digestion]. Moscow, 1948, pp. 86-133. Abstr.: *Soviet. med. refer. Obozrenie, Fiziol.*, 1949 (4):16.

Salivary secretion in man, and in dogs having a parotid fistula, as well as canine gastric and bile secretions, were studied at altitudes of 2200 meters during 17 days, at 4200 m. during 25 days, and at 4800 m. during 2 days. Salivation at 2200 m. is initially considerably reduced, but returns to normal after 8 to 10 days; salivary sugar and urea content also show a sharp drop. Salivary inhibition, initially present at 4250 m., gradually disappears in 10 days; amylase appears in the saliva. Little change was noted in salivation after 3 months on the Elburz mountain range, as a result of acclimatization. The gradual return of the digestive secretions and excretion, to the normal observed on the lowland plain, is considered to be a process of adaptation.

Ruegamer, W. R., 1955. LACK OF SYNERGISTIC RELATIONSHIP BETWEEN THYROID AND SALIVARY GLAND FUNCTION. *Proc. Soc. exper. Bio. Med.*, 90.(1): 146-148.

I^{131} -labeled diiodotyrosine, triiodothyronine, thyroxine, and iodide in 15 μ g/kg. body weight

doses were injected intravenously in 5 dogs under pentobarbital anesthesia. Determinations were made of the iodide content of plasma and of Mecholyl-stimulated samples of saliva by means of paper chromatography and a scintillation well counter. Results show the salivary presence of only I^{131} in detectable amounts, as well as a relatively constant clearance of I^{131} into the saliva over a 24-hour period. Addition of thyroid substance at 0.5% of the diet of a dog for 2 months failed to influence I^{131} clearance. Salivary excretion of iodide appeared to be a function of the iodide level of the plasma and not dependent on the blood level of thyroid hormone. Salivary and thyroid gland studies concerning diiodotyrosine metabolism in the dog and in the rat are described and discussed.

Ryan, E. J., and S. Kirkwood, 1955. EXPLANATION OF THE EFFECT OF FEEDING DESICCATED THYROID ON THE INCIDENCE OF DENTAL CARIES IN THE RAT. *Science*, 121 (3136): 175-176.

The feeding of desiccated thyroid has been found to result in increase in weight of the submaxillary gland in the rat. This is considered as probably due to increased degradation of the excess thyroid hormone producing an increased concentration of iodide ion in the saliva, as well as to increased salivation. It is suggested that the iodide ion in solution in saliva has an anticariogenic action.

Ryan, J. G., 1909. THE VARIATIONS IN THE ENZYME CONCENTRATION WITH THE VARIATION IN THE BLOOD SUPPLY TO THE SECRETING GLAND. *Amer. Jour. Physiol.*, 24 (2): 234-243.

The amylolytic powers of rabbit saliva were examined. Ptyalin concentration was determined by the rate of clearing of a starch solution and by the time of complete disappearance of erythrodestrin.

Submaxillary saliva and parotid saliva were collected during ether anesthesia and without anesthesia (method is described). In salivas obtained during anesthesia, the submaxillary saliva was found to be almost devoid of amylolytic power; parotid saliva was highly active, equal to, and sometimes even greater than, human parotid saliva. In one case only, the parotid saliva of a healthy rabbit showed no action on starch; the serum of the animal was found to be entirely free from diastase. No explanation is offered.

Eight series of successive samples of saliva, four obtained by stimulation of Jacobson's nerve and four by pilocarpine injection, showed a rapid decrease of amylolytic power in the course of the experiment but varied considerably in rate of action; when the gland approached fatigue, the ptyalin almost entirely disappeared. The ptyalin concentration during a period of activity seems to run the same course as that of organic solids.

In a series of six experiments employing simultaneous stimulation of Jacobson's nerve and the cervical sympathetic, alternating with stimulation of Jacobson's nerve alone, uniform results in increase of ptyalin content were produced by stimulation of the cervical sympathetic.

In another series of six experiments, both common carotids and both vertebral arteries were clamped off. The oxygen supply to the parotid glands was reduced, causing an increase of ptyalin concentration in parotid saliva.

Results of experiments conducted without anesthesia show the same fluctuations as those with anesthesia.

Sabin, Albert B., and Isaac Ruchman, 1940. SPREAD OF VIRUS IN AN UNVACCINATED CASE OF HUMAN RABIES. *Proc. Soc. exper. Biol. Med.*, 44 (2): 572-577.

Among other body tissues and fluids, the saliva of a 55-year-old man who died of rabies 2 months after a bite on the hand by a rabid dog, was examined for the rabies virus. Results were negative, but could possibly be due to inadequate methods.

Sacks, J., and M. S. Kim, 1929. ON THE NON-EXISTENCE OF A HORMONE FOR SALIVARY SECRETION. *Proc. Soc. exper. Biol. Med.*, 27 (3): 183-184.

The application of two different methods failed to present any evidence for the existence of a hormone mechanism for salivary secretion. In the first series of tests, the mucous membrane of several anesthetized dogs (having cannulated Wharton's ducts) was extracted with 0.4% HCl and quantities of extract sufficient to lower the blood pressure 60 to 80 mm. Hg were injected intravenously. There was no evidence of increased secretion from the cannula; marked increases were produced by stimulation of the chorda tympani. Using the other method, a fistula of Wharton's duct was made in two dogs, and, after recovery, a 0.4% HCl solution was applied to the tongue daily for 3 weeks. A considerable flow of saliva was thus produced. Thereupon, the cervical sympathetic and chorda tympani nerves were sectioned. Two days later, the acid applications were resumed, without any success in producing secretion.

The two tests indicated the absence of any hormonal mechanism for salivary secretion.

Sajous, Charles E. de M., 1923. THE ENDOCRINE GLANDS IN RELATION TO DENTAL NUTRITION AND CARIES. *Dental Cosmos*, 65 (7): 702-713.

Adrenoxidase is revealed in saliva by an adrenaline-H₂O₂ test. The oxidizing enzyme is considered to impart a bacteriolytic effect to the saliva.

Sallay, Cornelia, and Charles Nador, 1950. CHANGES IN THE KALLIKREIN CONTENTS OF SALIVA UNDER PHYSIOLOGICAL CIRCUMSTANCES AND IN PERIODONTOPLASIA. *Jour. dental Res.* 29 (2): 232-236.

The kallikrein contents of saliva were determined by injecting 1 cc. of saliva into the femoral vein of a dog and observing the resulting drop of carotid blood pressure. To achieve standardized results, the dogs were anesthetized with 0.4 cc. of Pernoston (10% solution of sodium butyl 3-bromallylmalonylurea) and 0.01 g. of morphia per kg.; 0.005 g. of atropine per kg. was administered to eliminate possible acetylcholine effects. Artificial respiration was used. For the evaluation of the results, the blood pressure drops caused by saliva were compared with those produced by injection of solutions of a standard kallikrein preparation, Padutin.

The kallikrein contents were determined of physiologically normal saliva of 14 young (8 to 18 years) and 14 older (45 to 78 years) individuals. 1 cc. of saliva from the individuals in the 8-18 group contained 0.3 to 4.8 units of kallikrein (the latter in only one case), compared with the 2 to 8 units of kallikrein in the salivas of individuals between 48 and 78 years

years of age (one individual had 1.1 units). Age appeared to be the only physiological factor influencing the kallikrein content.

The kallikrein concentrations in the salivas of 17 patients (6 with primary paradontoclasia, 3 with ulcerative gingivitis, 3 with a marked predisposition to dental caries, and 5 whose teeth and gingivae were healthy) were examined and no difference was noted between the controls and the caries and the gingivitis cases. In periodontal diseases, however, the contents were 5 to 6 times that of the controls of the same age.

There appears to be a correlation between the physiological ageing of the periodontium and atrophy of the gingiva. This correlation could be seen in the examination of 6 patients with severe gingival atrophy.

The increase of kallikrein may be considered a biological process indicating ageing. There is inconclusive, yet supporting, evidence of premature ageing in periodontal disease. Liberation of kallikrein increases the permeability of the capillaries and may result in stagnation and inflammation on the gingival margin and thus affect the periodontal tissue.

Sanarelli, Giuseppe, 1892. DER MENSCHLICHE SPEICHEL UND DIE PATHOGENEN MIKRO-ORGANISMEN DER MUNDHÖHLE [Human saliva and the pathogenic microorganisms of the mouth cavity]. *Centralbl. f. Bakteriologie*, (1) 10 (25): 817-822.

Investigations were made on the relationship between saliva and the more common mouth bacteria. The saliva of healthy persons was filtered through a Chamberlain filter and 10-15 cc. of the filtrate (a colorless, neutral or slightly alkaline reacting, germ-free liquid) was collected in test tubes. The tubes were inoculated with bacterial types and incubated at a constant temperature of 37° C. A platinum loop, which had been immersed in a fresh bouillon culture or the condensation liquid of an equally fresh agar- or serum culture, was inserted and "rollplatten" (Esmarch) were prepared at regular intervals on which the increase or decrease of bacteria could be noted.

Results showed that human saliva must be regarded as a good nutrient for certain pathogenic microorganisms (such as *Staphylococcus pyogenes aureus* [*micrococcus pyogenes var. a.*] and cholera spirilla); that it has a bactericidal power to destroy the organisms if their numbers are small enough (or in the case of large numbers, to decrease them temporarily, only to be followed by normal increase); and that, although it permits the growth of pneumococci, it has the power to inhibit or even destroy the virulent action of the normal types of pneumococci.

Sanarelli, G., 1938. L'ALLERGIE HEMORRAGIQUE SALIVARIE [Salivary hemorrhagic allergy]. *Compt. rend. Soc. Biol.*, 129: 1049-1052.

Description is given of a method of producing anaphylactic shock in rabbits, using human mixed saliva from healthy subject to prepare the anaphylactogen. Three intravenous injections of 10 cc. of such saliva, sterilized for 1 hour at 60°C., at 24 hour intervals produces fatal shock in the experimental animals. Subcutaneous or peritoneal injections of the sterilized saliva,

as well as intravenous injections of the supernatant fluid following normal sedimentation of the salivary sample, do not produce any allergic reaction. Immunity can be induced by intravenous injections of moderate amounts of sterilized saliva. The reaction is considered due to the normal bacterial flora of the human saliva.

Sand, Harald F., 1949. THE CARBONIC ACID CONTENT OF SALIVA AND ITS ROLE IN THE FORMATION OF DENTAL CALCULUS. Thronsen & Co., Oslo. 141 pp.

The etiological factors concerning dental calculi are presented in this thesis which includes the following: a discussion of the theories of calculus formation, a description of a salivary collection apparatus, determinations of salivary absorption coefficients (at 38°C and below), combined carbonic acid content, and total carbonic acid content, methods for determining salivary gland and/or salivary carbonic anhydrase, blood content, and carbon dioxide escape, location of dental calculi, the importance of ammonia production, and the calculation of the calcium and phosphate ion content of saliva at various carbon dioxide tensions.

The relationships of the findings to dental calculi are discussed and summarized.

Sand, H. F., 1951. SOURCE OF THE BICARBONATE OF SALIVA. Jour. applied physiol., 4 (2): 66-76.

Determinations were made of the bicarbonate concentrations of blood and saliva of 3 subjects during a period of acidosis induced by ingestion of NH_4Cl . No correlation was found between bicarbonate levels in the two fluids. Ten experiments were conducted in the rabbit intravenously administered C^{14} -labeled sodium bicarbonate; two other experiments involved similar administration of radioactive lactate. Results show no equilibrium between bicarbonate in blood and in saliva. Specific activity of bicarbonate was found to be higher in plasma than in saliva 2 hours after injection of radioactive bicarbonate, but higher in saliva than in plasma after injection of the lactate. The results indicate that salivary bicarbonate is formed in the salivary glands during the secretion process.

Sanders, Robert G., and George F. Reddish, 1945. ORAL MICROORGANISMS. I. THE TYPE OF ORAL MICROORGANISMS ISOLATED FROM MOUTH RINSINGS PLATED IN NUTRIENT AGAR. Jour. Bacteriol., 49 (6): 635.

A study of the cultural and morphological characteristics of microorganisms cultured from mouth rinsings of 19 normal subjects (over 50 isolations) showed that 90 per cent of the 50 isolations were micrococci (60% Gram-positive and 40% Gram-negative) and the other 10%, Gram-negative rods, yeasts, and sarcina.

The determination of the carbohydrate fermentation of the oral micrococci and a study of a possible relationship of acid production to dental caries were made.

Sandholzer, L. A., 1938. BACTERIOPHAGE AND LYSOZYME IN RELATION TO ORAL INFECTIONS. Jour. Amer. dental Assoc., 25 (9): 1399-1405.

An extensive review of the biochemical properties of bacteriophage and of lysozyme and

of their significance in oral infections. The principal difference between the two agents is that lysozyme destroys both living and dead cells, bacteriophage only living; the optimum temperature for lysozyme is 60°C., that for bacteriophage is usually that which is optimum for the host; lysozymal activity is independent of the age of the culture, diffuses evenly in agar cultures producing broad inhibition zones, and is partially non-filtratable; while bacteriophage activity has opposite characteristics. While both agents demonstrate a certain amount of specificity, that of lysozyme is less pronounced. The significance of the two agents in oral infection is not known.

Saphir, William 1940. XEROSTOMIA SUCCESSFULLY TREATED WITH NICOTINIC ACID. Amer. Jour. Digest. Dis., 7 (7): 298-299.

The case history of a 49 year-old female is presented in which the primary complaint was extreme dryness of the mouth (oral membranes), and in which no local pathology of the teeth or salivary glands, no significant physical findings, and no Vitamin B-deficiency signs could be detected by examinative procedures.

Yeast, nicotinic acid, and thiamine HCl (all Vitamin B fractions) were administered with remarkable results - the patient showed considerable improvement over a two week period. It was later found that nicotinic acid alone was sufficient in alleviating the oral cavity dryness, and thus, the author attributes this particular case of xerostomia to niacin deficiency.

Sarzhevskaiâ, L. A., 1955. K VOPROSU O VLIIANII DEIATEL'NOSTI SLIUNNYKH ZHELEZ NA SOSTOIANIE ZUBOV [On the influence of salivary secretion on the condition of the teeth]. Stomatologiya, 1, 28-33.

The influence of salivary secretion on dental condition was studied in 130 white rats. The experimental animals were divided into three groups, intact controls, those with excised submaxillary or parotid glands, and those with ligated salivary ducts. Excision of both the submaxillary and parotid glands or ligation of the corresponding ducts was followed in 22 animals by considerable deterioration of permanent teeth with deep cavities and surface defects. The cavities were distal and fissured in most cases. Defects of hard dental tissue were less numerous after excision of the submaxillary glands alone; surface defects were noted in two of 14 rats and deep cavities in one. Ligation of submaxillary and parotid ducts in 25 animals preceded the appearance of surface defects in 11 and deep cavities in 4; deep defects were less numerous than among animals having excised glands. Four of 30 rats showed surface defects, and one showed deep cavities after parotid duct ligation alone; hard dental tissue changes were less pronounced than after ligation of both ducts. The least pronounced defects occurred after ligation of the submaxillary ducts; such defects resembled those found after extirpation of submaxillary glands. Results obtained after gland excision or duct ligation were different, although in both cases the saliva was absent from the mouth. The changes in the amount and quality of the saliva are not considered the main factors leading to dental caries. The more

pronounced deterioration of teeth is possibly due to the damage suffered by the nerves innervating the salivary gland after its excision. The appearance of surface deterioration after the ligation of the ducts confirms the relationship between saliva and dental metabolism.

Sasaki, Hakaru, 1932. UEBER DAS VORKOMMEN GRUPPENSPEZIFISCHER EIGENSCHAFTEN IM SPEICHEL UND ANDEREN KÖRPERFLÜSSIGKEITEN UND DEN NACHWEIS ZWEIER "AUSSCHIEDUNGSTYPEN" [On the occurrence of group specific properties in saliva and other body fluids and on the determination of two "secretory types"]. Zeitschr. f. Immunitätsforsch., 77 (1-2): 101-129.

Saliva studies indicate the existence of two types of persons--those which secrete the serological blood-group characteristics in saliva and those which do not; moreover, that this phenomenon is regulated by a principle independent of the blood group. In saliva of group AB, both characters A and B act in the same way. Inhibition of O-agglutination (with the anti-O of beef serum) occurs with the salivas of all secretory groups. The salivary O substance is destroyed by the blood-group enzyme of saliva or tissue; boiling destroys the enzyme and makes the substances A, B, and O stable. No M and N characters were observed in saliva.

Sato, T., 1934. "BLUTGRUPPENFERMENT" UND BLUTGRUPPENSUBSTANZ IM SPEICHEL ["Bloodgroup enzyme" and blood group substance in the saliva.] Klin. Wochenschr., 13 (22): 798-800.

An earlier study (Witebsky et al, 1933) suggested that the appearance in body secretions and excretions of the enzyme, attacking the blood-group specific-substance, is exogenous. In further tests of the group specific substance, samples of human saliva from a Group A subject were divided into two portions; one portion was boiled, the other untreated. Overnight incubation at 37°C showed the group specific-substance present in the boiled saliva but absent in the untreated portion. presence of the group specific-substance enzyme was also noted in salivary samples from Group O subjects in tests utilizing peptone (Witte) test serum to determine the presence of Group A specific substance. Notable amounts of both the group specific substance and its enzyme were found only in misty saliva collected before thorough mouth rinsing. Salivary samples collected after mouth rinsing were clear; 24 hours of incubation at 37°C showed almost complete absence of enzymatic activity while little reduction in group specific substance was noted.

Saunders, A. M., 1928. FLUCTUATION IN THE HYDROGEN-ION CONCENTRATION OF SALIVA IN EPILEPSY. Jour. Amer. med. Assoc., 91 (4): 244-245.

The hydrogen-ion concentration of the salivas of 10 persons, 2 normal and 8 epileptics, was determined at 15-minute intervals over 5 to 7 hours (La Motte method); fluctuations were graphed. In general, marked fluctuations were observed in 3 persons subject to frequent epileptic fits, who had seizures during the experiments: the pH ranged from 6.5 to 7.3, from 6.5 to 7.4, and from 5.8 to 7.1. The pH of 2 patients who had had convulsions shortly before

the experiment ranged from 6.3 to 7.2, and from 6.8 to 7.4. In the two normal individuals the pH range was from 6.9 to 7.1 and from 6.6 to 7.0. The pH of 3 epileptics having infrequent convulsions was 6.2 to 6.7, 6.8 to 7.2, and 6.8 to 7.2. The fluctuations of this group were less abrupt as well as confined to a smaller range than those of the individuals subject to frequent attacks.

Savara, Bhim Sen, 1955. RELATION OF SALIVARY LACTOBACILLUS COUNTS TO METHYL RED GLUCOSE RINSE test. Jour. Dental Res., 34 (5): 724.

Lactobacillus counts were made from the salivas of 21 persons who were then given a glucose rinse-methyl red test to indicate "caries-susceptible" dental areas of pH 5.0 or less. Data showed no direct association between lactobacillus counts and the number of "susceptible" dental areas. A similar lack of correlation between lactobacillus counts and "susceptible" areas was found in a second group of 55 persons receiving the pH test prior to the lactobacillus count. In a third group of 4 dental hygiene students, 28 glucose rinse-methyl red tests and lactobacillus counts were made at different times of the day; the data showed no correlation. Lactobacillus counts, made of pre-breakfast salivary samples in 23 persons, showed no correlation with methyl red positive tooth surfaces observed during the day. (From author's abstract).

Savinskaja, A. P., 1954. K VOPROSU O RABOTE PARNYKH SLIUNNYKH ZHELEZ [On the function of the paired salivary glands]. Biull. eksper. Biol. Med., Moskva, 37 (2): 12-17.

Bilateral comparison was made of the rate of parotid salivation to conditioned and unconditioned stimulation in four fistulated dogs. Wet rusk-meat powder was used as an unconditioned stimulus and various sound or light signals as conditioned stimuli. Results of over 1000 experiments on the unconditioned reflex in each dog during a 3-year period showed salivation, and occasionally the latent period, to be unequal in the two glands. Neither gland showed any regular dominance in secretion. Extensive experiments, using a wide variety of combinations of the unconditioned stimulus with conditioned stimuli, showed conditioned salivation from both parotid glands to be unequal in secretion rate and in length of latent period. Ingestion of 0.3 gm. of caffeine in milk, 30 minutes before application of the conditioned stimulation, equalized the conditioned salivation in dogs of a weak nervous type while a 0.6 gm. dose increased inequality in secretion and depressed the positive conditioned reflexes; the 0.6 gm. dose equalized bilateral secretion in dogs of a strong nervous type. The establishment of differential inhibition proceeded unequally in dogs showing incomplete differential inhibition, even after numerous stimulations; this inequality disappeared only in the strong nervous type, on establishment of complete differentiation. Extinction of the conditioned reflexes also proceeded unequally in the two parotid glands. Subcutaneous injections of pilocarpine in 10 tests each in dogs of weak and strong type showed in both types of dog a bilateral inequality of secretion that was more accentuated in the weak type. The bilateral

inequality in parotid salivation is considered to depend on a difference in the functional state of the central nervous system.

Savosti'ianov, G.M., 1937. K VOPROSU O NITRATAKH SLIŬNY [On the question of nitrites in saliva]. Fiziol. Zhur. SSSR, 23 (1): 159-164.

The participation of the oxydoreductase, contained in the salivary glands, in the formation of the nitrites of saliva was studied. The isolated salivary gland was carefully ground with its equal weight of quartz sand, degreased by acetone, dried between sheets of filter paper and kept in petroleum-ether. To determine the oxydoreductase content, 1 gm. of the gland powder was mixed with 4 cc. of phosphate mixture pH = 7.8, 1 cc. of 20% carbonate of sodium and 1% acetaldehyde. The mixture was placed for 30 min. in a water-bath at 60°; 1 cc. of a saturated solution of $\text{Pb}(\text{CH}_3\text{COO})_2 \cdot 2\text{Pb}(\text{OH})_2$, or 1 cc. of a saturated alcohol solution of ZnCl_2 was then added. The liquid was filtered and an equal amount of Hosway Lunge's reagent added. The nitrite obtained was determined by the calorimetric method. All the following results are tabulated.

In a great number of determinations, the submaxillary gland was always found to contain a certain amount of the enzyme; it was often absent from the parotid gland; if present, the content was lower than in the submaxillary gland.

In the saliva, the oxydoreductase was determined by the same method, using 2 cc. samples of saliva. In no case could oxydoreductase be found. Every saliva contains, however, nitrites, which varied in amount from 0.01 to 0.1 mg./100 cc. of saliva. Values above 0.1 mg./100 cc. of saliva are very rare.

In a few tests, 1 gm. sodium nitrate was daily given to the subjects per os during several days; the amount of nitrite was determined in the saliva before and after this administration, after careful cleansing of the mouth. Results showed that after the introduction of NaNO_3 the amount of nitrites in the saliva increased [more than double]. The increase of nitrites in saliva is considered to be due to the oxydoreductase in the salivary glands.

Verification tests were made in the isolated salivary gland of the dog. The amount of nitrite was determined in chorda saliva before administration of sodium nitrate; then 20 cc. of a 10% NaNO_3 solution was injected into the femoral vein, the chorda stimulated every 10 min., and the quantity of nitrites determined in each salivary sample. Results showed little change in the amount of nitrite in the saliva of the isolated gland. Thus, no confirmation could be obtained in this case. It was observed, however, that after conservation of the saliva with sodium nitrate for one or two days, the amount of nitrite was greatly increased. After conservation of the saliva without sodium nitrate, the amount of nitrite fell, after 1 to 2 days, to zero.

If a mixture of 2 cc. of fresh saliva and 2 cc. of a sodium nitrate solution are incubated several days at 37° C, a sharp increase in nitrite content is observed.

A still more striking transformation of NaNO_3 into N_2O_3 by saliva is observed in hydrogen medium [200 to 400 times greater than in air medium, according to table].

When the mixture of saliva and sodium nitrate is boiled or sterilized, the change into nitrite does not occur.

When the saliva has been standing several days and sodium nitrate is then added, the formation of nitrite proceeds very intensively.

If the mixture of fresh saliva and sodium nitrite has been standing one or two days at 37°, not only the nitrite of the saliva, but also the added nitrite disappear. Tests with diphenylamine and Nessler solution showed that the nitrite had not changed back into nitrate, nor was there any presence of ammonia.

The author concludes that the change of nitrites is due to the action of living microorganisms. This assumption was confirmed by cultures made from microorganisms isolated from the saliva (bacilli and staphylococci).

Schainis, M. E., 1939. CORRELATION OF SALIVA TESTS FOR CARIES ACTIVITY. Jour. dental Res., 18 (3): 285-286.

Stimulated saliva samples were tested by the Fosdick-Hansen chemical susceptibility test to determine the number of mg. of calcium that would be dissolved by saliva in four hours. The mg. dissolved were plotted against the number of salivary bacterial colonies formed on tomato agar plates. A definite correlation between calcium dissolved and the number of bacterial colonies occurred in 83% of the cases; in 55%, there was a very close correlation, that is, high bacterial counts occurred when large quantities of calcium were dissolved by saliva, and vice versa.

Scheer, K., and Fuhrberg, 1928. ÜBER EIN SPEICHELFERMENT [On a salivary enzyme]. Zeitschr. f. Kinderheilk., 38 (1-2): 115-122.

The presence of lipase in human saliva was determined. A study of its properties showed the lipase to be more active in parotid saliva than in other salivary secretions; to be a direct product of the gland and not due to microbial action; to be destroyed at 65° C.; to have an optimum pH of 7; and to be concentrated by salivary desiccation and activated by CaCl_2 and by sodium oleate.

Scheer, K., 1928a. ÜBER LIPASE IM SPEICHEL [On lipase in saliva]. Klin. Wochenschr., 7 (4): 163-165.

Saliva studies indicated the existence of a lipase as a natural constituent. The lipase is destroyed by heating at 65° C. for one hour, has an optimum pH of 7, and is stronger in parotid than in other secretions. Its activity is increased to 300% by calcium chlorate and by sodium oleate. It is concentrated by desiccation.

Schermerhorn, A. R., 1925. THE DIASTASE ACTIVITY OF HUMAN SALIVA AND THE EFFECT OF DENTIFRICES UPON IT. Dental Cosmos, 67 (3): 238-244.

The ptyalin index of a subject's saliva was determined daily for seven days by incubating various dilutions of saliva with a distilled water-potato starch suspension (30 minutes at 40° C.) to calculate the amount of saliva containing sufficient ptyalin to digest 1 g. of starch.

To test the effect of 3 soap-containing alkaline and 3 soapless acid dentifrices upon the ptyalin index of saliva, the mouth was rinsed with a 4% aqueous solution of a dentifrice

followed by frequent rinsings of the mouth for 1 minute. The ptyalin index was determined immediately, 30 minutes, and 1 hour after rinsing with a dentifrice. Results show that both types of dentifrices cause a depression in the index from about 800 per 100 cc. of saliva to approximately 200 immediately after rinsing. One hour later the index was found to be about 600 after rinsing with an acid dentifrice and around 700 after rinsing with an alkaline dentifrice. A second series of experiments were conducted to determine clearing time of a 1% starch suspension incubated at 37°C. after addition of 1 cc. of saliva. The mouth was rinsed with a dentifrice and water as in the first series. Samples of saliva were collected immediately after rinsing and at 5-minute intervals thereafter. Both acid and alkaline dentifrices caused an increase in clearing time over that determined for saliva collected prior to rinsing. The acid dentifrice caused a greater increase in clearing time over a longer period of time than the alkaline substance.

Scheunert, Arthur, and A. Trautmann, 1921. ZUM STUDIUM DER SPEICHELSEKRETION. I. Über die Sekretion der Parotid des Pferdes [Study of salivary secretion. I. Secretion of the parotid of the horse]. Pflüger's Arch. ges. Physiol., 192 (1-2-3): 1-32.

The salivary secretory process of the horse is examined. The discussion of the physiological phenomena includes the stimulation of secretion, the role of mastication, and the course and quantity of salivary secretion under various test conditions. Histological examination of the parotid gland of the horse is analyzed in great detail.

Scheunert, Arthur, and A. Trautmann, 1921a. ZUM STUDIUM DER SPEICHELSEKRETION. II. Über die Sekretion der Parotis und Mandibularis des Schafes [Study of salivary secretion. II. Secretion of the parotid and submaxillary glands of sheep]. Pflüger's Arch. ges. Physiol., 192 (1-2-3): 33-69.

The salivary secretory process in the sheep is discussed. Data on the time of secretion, the quantity and type of saliva collected from the cannulated parotid and submaxillary glands, are analyzed. Changes in chemical composition of saliva secreted by both pairs of glands at rest, during and after feeding are compared, and modifications of body weight and other physiological changes observed during the experiment are outlined.

Scheunert, Arthur, and A. Trautmann, 1921b. ZUM STUDIUM DER SPEICHELSEKRETION. III. Kritik und Schlussfolgerungen [Study of salivary secretion. III. Criticism and final conclusions]. Pflüger's Arch. ges. Physiol., 192 (1-2-3): 70-80.

A summary and analysis of previous work (Scheunert 1921 m,n) on salivation in the horse and sheep are presented.

Scheunert, Arthur, F. W. Krzywanek, and K. Zimmermann, 1929. ZUM STUDIUM DER SPEICHELSEKRETION. IV. Die Dauersekretion des Parotis des Schafes und ihre Bedeutung [Study of salivary secretion. IV. Continuous secretion of the

parotid of the sheep and its significance]. Pflüger's Arch. ges. Physiol., 223 (4-5): 453-461.

Continuous secretion of the cannulated parotid glands of male and female sheep of various weight has been investigated. The quantity of the secreted saliva varied at different times in the same sheep and did not depend on the size of the animal. In general, both glands secreted saliva completely independently from each other.

A definite decrease in secretion was noted in animals tested for several days; after 7 to 10 days, glandular function was suspended completely after the cannula had slipped from the parotid duct and the wound healed up. While the fistulated sheep died due to water and alkali loss, the cannulated animals could be kept alive because of the edematous changes in the parotid gland acting as a defense mechanism. Following the termination of parotid function in the cannulated group, a disturbance in food intake and an increase in water consumption were observed. With improved nutrition and with the urinary output returning to normal, however, the life of the animal was secured. It is concluded that the secretion of the parotid gland as such is not absolutely essential to life, but the continuous loss of water and alkali may cause serious disturbances.

Scheunert, A., F. W. Krzywanek, and K. Zimmermann, 1929a. ZUM STUDIUM DER SPEICHELSEKRETION. V. Der Einfluss verschiedener Reize auf die Sekretion der Parotis des Schafes. [The effect of different stimuli on the secretion of the parotid of the sheep]. Pflüger's Arch. ges. Physiol., 223 (4-5): 462-471.

The effect of psychological and chemical stimulations was investigated on the rumination and food absorption of the sheep. Just as in the horse or cattle, psychological stimulation (tantalizing with fodder) did not result in an increased salivary secretion. A slightly increased salivation noted in a few cases was preceded by active tongue and lip motions of the animal. Similarly, no significant increase in saliva production was observed following chemical stimulation (ingestion of glucose and/or sodium chloride); coumarin solution had a slight stimulating effect in one sheep.

The effect of rumination was studied on the continuous saliva secretion. Mastication on the right side usually induced a decrease in the salivary secretion of the left parotid; mastication on both sides, however, increased salivary secretion considerably. The reaction of the parotid to various stimulants fluctuated but it was noted that the more considerable was the continuous resting salivary output of an animal, the greater was the influence of mastication.

The ingestion of hay or chopped straw acted as a strong stimulant on the activated parotid, while the second parotid reacted just as after ruminating. Ingestion of oats and beets, however, stimulated the salivary function of both parotids. This was due to the size of bites; coarse fodder was masticated in small bites on one side, in the mastication of fresh fodder, on the other hand, the full denture and the whole oral cavity was involved. It was concluded that mechanical stimulation had the most considerable effect on the salivary secretion of the sheep.

Scheunert, A. and F. W. Krzywanek, 1929b. ZUM STUDIUM DER SPEICHELSEKRETION. VI. Über die an der Dauersekretion des Schafes beteiligten Drüsen und die Zusammensetzung des von ihnen gelieferten Sekretes [Study of salivary secretion. VI. On the glands participating in the continuous secretion of the sheep and on the secretion so furnished]. Pflüger's Arch. ges. Physiol., 223 (4-5): 472-476.

A glass tube was inserted in the esophagus of the sheep to obtain saliva after swallowing. The swallowed saliva was quite considerable (in one sheep about 19 liters were collected in 24 hours.) Then the left parotid duct and, one hour later, the right parotid of the same sheep were cannulated. The formation of the continuous secretion indicated that this was composed not only of parotid saliva but also of secretion from other glands, which equalled the secretory capacity of both parotids. The secretion of the left parotid was greater than that of the right. The increase of the salivary output of one parotid gland did not necessarily influence the activity of the second parotid. Five hours later the total salivary output decreased by 50%. The next day the decrease was even more conspicuous in the same animal. The amount of salivary secretion varied individually but the participation and distribution of the individual gland secretions were the same. Besides the parotid glands, the submaxillary, sublingual glands and other smaller glands in the oral cavity (especially well-developed in the sheep) shared in the salivation process. The secretion of all these glands not only replaced the gastric juices, decreased in the rumen during the digestive process, but they also helped to neutralize the contents of the rumen. The salivary ash contained sodium- and potassium bicarbonate, and carbonate with phosphate and chloride.

Schiff, Fritz, 1940. RACIAL DIFFERENCES IN FREQUENCY OF THE "SECRETING FACTOR." Amer. Jour. Phys. Anthropol., 27 (2): 255-262.

"Secretors" have a blood group specific substance which is also found in their saliva, while the "non-secretors" show no such salivary factor corresponding to the blood substance. Tabulations from studies of Berlin Whites, New York Whites, and Harlem Negroes indicate that the relationship of secretors to non-secretors in the two groups of Whites shows no significant differences, however, the relationship between the Berlin and New York groups, and the Negro group is indicative of an existent racial difference in the relative proportion of secretors to non-secretors.

Schiff, J., and F. Alonso Buron, 1935. ZUR KENNTNIS DER SOGENNANTEN BLUT-GRUPPENFERMENTS [Information on the so-called blood group enzymes]. Klin. Wochenschr., 14 (20): 710-712.

Fluctuations of salivary blood group enzymes in the same individual may be due to fasting, the type of food ingested, rinsing of the mouth, seasonal changes, etc. It was easy to discriminate between salivary samples rich or poor in group enzymes; a considerable amount of enzymes in the saliva was simultaneously noted with rich sedimentation. Salivary samples which were cooled while being collected and then centrifuged soon after were poor in group enzymes. However,

when the saliva was left at room temperature before being centrifuged, the enzyme content of the solution could be easily ascertained. Saliva obtained in a passive way, without too much muscular activity, was lighter and almost completely free of group enzymes. Fasting saliva was always rich in group enzymes but rinsing of the mouth or ingestion of food yielded a salivary sample richer in liquid but poorer in enzymes.

Schlack, Carl August, Charles Davidson Hemphill and Donald N. Taylor, 1942. EFFECT OF DRYING ON BACTERIAL COUNTS OF ORAL MUCOUS MEMBRANES. Jour. dental Res., 21 (4): 379-381.

"From the anterior maxillary area the number of colonies on plates made from wet mucosa varied from 4,288 to 105. Eighty per cent of the total wet counts approximated the 4,288 count and 20 per cent of the total wet counts approximated the 105 count. The number of colonies on plates made from the dried mucosa varied from 1152 to 0. Twenty per cent of the total counts approximated 1152 count and 80 per cent of the total counts fell between 400 and 0 counts. The average number of colonies from the wet mucosa was 2599. the average number of colonies from the dried mucosa was 339.

"For the mandibular foramen area the colony counts from the dried mucous membranes varied between 23 and 2304 with an average of 811. The colony counts from the wet mucosa varied between 640 and 5568 with an average of 2357."

"From the experimental findings it appears that drying might be one factor in reducing the number of living organisms present on the oral mucosa of the external alveolar plate above the gingivae between the canines of the maxillae, and at the site of the injection for the mandibular nerve near the mandibular foramen." (Author's summary and conclusions.)

Schlack, Carl August, and Winter J. Edwards, 1943. NUMBER AND DISTRIBUTION OF MUCOUS GLANDS OF THE HARD PALATE (a preliminary report). Jour. Amer. dental Assoc., 30 (3): 224-225.

The numerical distribution of secretion glands was studied on an area of the hard palate adjacent to the first molar tooth. 42 male patients between the ages of 19 and 36 years were employed in the study. Three equal areas of the palate were marked, and the small mucous droplets (secretions of the glands) in each area were counted with the aid of the throat light and a magnifying glass. The average number of glands in the areas examined was 11.7. The average number of glands in the mesial third was found to be 5.2; the middle third, 5.6; and the lateral third, 0.85.

Schlesinger, A., 1891. ZUR KENNTNIS DER DIASTATISCHEN WIRKUNG DES MENSCHLICHEN SPEICHEL, NEBST EINEM KURZEN ABRISSE DER GESCHICHTE DIESES GEGENSTANDES [On the diastatic activity of human saliva, in addition to a short outline on the history of this substance]. Virchow's Arch. pathol. Anat., 125 (1): 146-181.

A short historical survey of salivary studies is followed by a detailed analysis of salivary diastatic activity, salivary microorganisms, composition of mixed saliva, saccharification process in the newborn, in infants, and in various animals. The enzymatic activity of pathological saliva, and the correlation between saliva and gastric acidity is discussed.

Schmidt, Hans Joachim, 1939. DER EINFLUSS DES TABAKS AUF BAKTERIENFLORA, SPEICHELZUSAMMENSETZUNG UND VERDAUUNG [The influence of tobacco on the bacterial flora, saliva composition and digestion]. Zeitschr. f. Stomatol., 37 (9): 497-502.

A review of the literature on the influence of tobacco on bacteria and saliva led the author to the following conclusions: (1) Since tobacco smoke affects the growth and viability of certain microbes, defensive agents (such as bacteriophage) are similarly affected. (2) Smoking increases salivary secretion, which may possibly enhance its cleansing properties; it appears that smoking may injure the general health of the individual, either by destruction or reduction of the normal calivary constituents. (3) Smoking decreases the appetite, decreases the digestion in the oral cavity, and affects the gastric secretions. No experimental data.

Schmidt-Nielson, Bodil, 1948. SOLUBILITY OF TOOTH SUBSTANCE IN RELATION TO THE COMPOSITION OF SALIVA. Jour. dental Res., 27 (2): 222.

"Saliva contains variable amounts of hydroxyapatite. Tooth enamel is soluble in saliva only when the hydroxyapatite content is below the saturation point. Saliva collected after stimulation is not suitable for this study. Unstimulated or resting saliva is available in sufficient quantity and can be collected in most subjects within ten minutes. One and one-tenth cubic centimeter is sufficient for analysis. Resting saliva is not affected by the time of day or by food ingested. The protein calcium content is constant. Parotid saliva has a more constant hydrogen-ion concentration than does mandibular saliva, usually pH 5.48. It is less saturated with hydroxyapatite than is manibular saliva." (Complete paper.)

Schnack, A. G., 1932. DENTAL CARIES. Jour. Amer. dent. Assoc., 19 (1): 62-68.

Theories of caries formation are reviewed and the role of saliva in tooth decay is discussed. The author believes that there are three possible causes of dental caries: a reduction in the buffering capacity of saliva which favors the concentration of acids resulting from the activity of acidogenic bacteria; regurgitation of acid from the stomach; and, the establishment of and fermentation by acid-producing organisms in the oral cavity and about the teeth which is favored by ingestion of highly fermentable and adherent foodstuffs, oral stagnation of fluids (especially saliva), and concentration of saliva during sleep and illnesses.

Schneider, E. C., 1901. ON THE VARIATIONS IN THE SULPHOCYANIDE CONTENT OF HUMAN SALIVA. Amer. Jour. Physiol., 5 (5): 274-280.

Of 225 saliva samples of healthy young persons, tested by the Solera-Kruger method, all but one showed the presence of sulfocyanide. No explanation is offered for the exception.

Quantitative determinations, made according to Munk's method, in 100 cc. samples of saliva of 20 individuals, showed the average potassium sulfocyanide content to be 0.007%. In smokers, the average was 0.013%, in non-smokers 0.003%.

The application of a colorimetric test divided the individuals into three groups:

(1) persons whose saliva reaction showed "traces" of potassium sulfocyanide (those who produced a weaker color than that afforded by a 0.0016% KSCN solution); (2) those who produced a "weak" reaction (i. e. produced a color stronger than that obtained with a 0.0016% KSCN solution); and (3) those who produced a "strong" reaction (more so than that yielded by a 0.008% KSCN solution). Of the smokers, 1% was in Group (1), 23% in Group (2), and 76% in Group (3); of the non-smokers, 23% was in Group (1), 72% in Group (2), and 5% in Group (3).

No systematic study of the influence of smoking on the sulfocyanide content of saliva was made. It was noted, however, that in one individual the KSCN reaction increased with an increased use of tobacco; in another individual the sulfocyanide reaction obviously decreased during a 10-day period of abstinence from tobacco, returning to previous value when smoking was resumed. The daily sulfocyanide content of saliva seemed to be individually constant in healthy persons.

Prolonged stimulation of the salivary glands diminished the excretion of sulfocyanide considerably. No correlation was seen between sulfocyanide content and other saliva composition (organic matter, etc.).

The relative intensity of the sulfocyanide reaction in the parotid and submaxillary saliva of over 50 individuals was measured by means of the Solera-Kruger test paper. The submaxillary saliva had uniformly less sulfocyanide content than the parotid. With regard to intensity of reaction, the parotid saliva gave the following results: of the smokers, 24 showed a strong reaction, 4 a weak reaction, and none "traces"; in the non-smokers, the distribution was 0, 22, and 2, respectively. The submaxillary saliva tests gave the following results: of the smokers, 11 showed a strong reaction, 13 a weak reaction, and 4 showed "traces"; in the non-smokers, the distribution was 0, 5, and 19, respectively.

Schneyer, C. A., and J. F. Volker, 1955. THE SALIVARY pH OF RODENTS. Jour. Dental Res., 34 (5): 765-766.

The salivary pH of hamsters, rats, and mice was determined by insertion of paper pH indicators into the oral cavity, by introduction of cellulose sponges into the mouth and pH determination of the absorbed saliva with a 1-drop glass electrode, and by similar determination of pilocarpine-stimulated saliva. The salivary pH of the rodent groups was found to vary from 8 to slightly more than 9. The pH of hamster saliva tended to approach the higher value, that of the mouse the lower value. Similar tests of human saliva gave readings between pH 6 and 7. A literature survey indicates that the salivary pH of ruminants is comparable to that of rodents. (From author's abstract.)

Schneyer, Leon H., 1950. EFFECTS OF TEMPERATURE ON SALIVARY AMYLASE ACTIVITY. Jour. dental Res., 29 (5): 696.

"Freshly collected mixed human saliva diluted with 0.25 per cent NaCl comprised the enzyme solution. Somogyi's iodine method was used for the determination of amylase activity. The activity of salivary amylase increases rapidly as the temperature is raised to 50° C. Beyond 50° there is a rapid drop in activity. The increase

in activity with a rise in temperature may be considered to result from the accelerating effect of temperature on the native amylase-starch reaction. The activation energy for this reaction is 17,654 calories. The appearance of the optimum and the decrease in activity as the temperature is raised are ascribed to the ascendancy of a denaturation reaction. The activation energy of this process is 57,254 calories. The denaturation may be reversed by a reduction in temperature. There is an equilibrium between native and reversibly denatured salivary amylase, as there is with trypsin and bacterial luciferase. The denaturation process is slowed by the presence of substrate and by NaCl. The antidenaturant action of the substrate appears to be due to the combination with the native enzyme." (Complete paper.)

Schneyer, Leon H., 1951. THE ROLE OF THE CATION IN THE SODIUM CHLORIDE ACTIVATION OF SALIVARY AMYLASE. *Jour. dental Res.*, 30 (4): 599.

"Salivary amylase, dialyzed free of salts, shows virtually no amylolytic action. The presence of 10^{-4} N sodium chloride restores activity. The activating component is considered to be the chloride ion. The results of this investigation indicate that, at temperatures near the optimum for amylase activity, the cation increases the degree of activation by chloride and does this by slowing the denaturation of the enzyme. A comparison of amylase activity in the presence of 3.6×10^{-2} and 3.6×10^{-3} N sodium chloride shows that with the greater NaCl concentration (1) amylase activity is greater at all temperatures within the 35 to 55° C. range; (2) the temperature optimum is at a higher value; and, (3) the rate of increase in activity as the temperature is raised to the optimum is greater, and the rate of decrease in activity is slower as the temperature is raised beyond the optimum. These effects indicate that NaCl slows the reversible denaturation of salivary amylase. Sodium chloride also reduces the irreversible denaturation of salivary amylase produced by temperatures above the optimum. The effects of increased sodium chloride concentrations can be obtained with lower concentrations of sodium chloride in the presence of sodium phosphate. Sodium phosphate alone is virtually without activating action. The effects of sodium chloride on the temperature response of amylase are, therefore, due to the sodium ion." (Complete paper.)

Schneyer, Leon H., 1951a. THE EFFECTS OF TEMPERATURE CHANGES ON SALIVARY AMYLASE ACTIVITY. *Jour. dental Res.*, 30 (1): 130-138.

The effect of various temperatures on the activity of salivary amylase was studied (method is described in full).

As the temperature rises up to 50° C. (optimum temperature) the salivary amylolytic activity increases correspondingly; above this temperature point, the activity rapidly decreases. The increase with temperature rise is attributed to the accelerating effect of increased temperature on native amylase-starch reactions, the heat of activity for this reaction being 22,742 calories.

The decreased amylase activity which occurs with a rise in temperature above the optimum point is attributed to amylase inactivation, the high heat of activation characterizing this reaction (denaturation) being 62,342 calories.

In the denaturation process, one step is readily reversible. The presence of substrate or NaCl may slow the denaturation process.

Schneyer, Leon H., 1952. THE EFFECTS OF UREA AND SALTS OF AMMONIUM PHOSPHATE ON SALIVARY AMYLASE. *Jour. dental Res.*, 31 (6): 767-774.

The effects of urea and ammonium phosphate salts on salivary amylase were studied at various temperatures. At 37-39° C. and pH 7, in the presence of 10^{-2} N NaCl, a 5-9% urea concentration (0.83-1.45M) has no effect on salivary amylase, while at temperatures above 50° C. or at low temperatures and in the absence of NaCl, the same urea concentration markedly inhibits salivary amylase (attributed to an effect on the denaturation process). A 0.1% (0.007M) concentration of ammonium phosphate counteracts the inhibitory properties of urea. The author doubts that urea in commercial dentifrices has an effect on the caries process by a denaturing action on salivary amylase.

Schneyer, Leon H., 1952a. THE EFFECT OF SODIUM AND POTASSIUM IONS ON THE TEMPERATURE BEHAVIOR OF SALIVARY AMYLASE. *Arch. Biochem. and Biophys.*, 39 (1): 65-76.

A report is presented of the effects at various temperatures of sodium chloride and potassium on salivary amylase. The amylase used in the determinations was separated from mixed human saliva by alcohol precipitation and centrifugation, and the resultant powder was then added to distilled water, filtered, and dialyzed. Solutions were made up to pH 8.8, and chloride-free starch was employed as a substrate.

At 37-53° C a 0.04 N NaCl solution containing the salivary extract revealed a greater amylase activity than did a 0.004 N NaCl solution, with the percentage difference in amylase activities increasing with increased temperature. The optimum temperatures for amylolytic activity in the .04 and .004 N NaCl solutions were found to be approximately 48° and 45° C respectively.

Differences in the amount of amylase activity, the rate of activity changes above 30° C, and the changes in optimum temperatures for amylase activity in these NaCl solutions indicated that sodium chloride acts as a denaturant or that it lends a protective effect against denaturation. Of three mediums tested, 0.04 NaCl, 0.004 NaCl, and 0.004 NaCl + 0.02 $\text{Na}_2\text{HPO}_4 \cdot \text{NaH}_2\text{PO}_4$ solutions, the greatest loss in amylase activity following the application of a high temperature occurred in the second solution, thus, the addition of sodium phosphate increased the protective action of the low concentration medium.

At a temperature of 10° C, observations indicated that amylase activity in a 0.004 N NaCl solution is as great as or is greater than that in a solution of 0.04 N NaCl. This fact was interpreted as cationic inhibition which became apparent at low temperatures because at that level the antidenaturant effect of the cation was no longer a significant factor. Potassium was demonstrated to be a greater inhibitor at 10° C than sodium.

It is concluded, by the authors, that sodium chloride increases amylase activity at temperatures above the optimum, but that at temperatures below optimum a reversal occurs and hydrolysis is decreased or reduced.

Schneyer, Leon H., 1953. INHIBITORS IN RELATION TO SALIVARY AMYLASE ACTIVITY: QUININE AND URETHANE. *Jour. dent. Res.*, 32 (4): 504-510.

In a digestion period of 12 minutes with a pH of 7.0 and in the presence of substrate and adequate NaCl, quinine and ethyl urethane were without significant effect on salivary amylase at 37° C. As the temperature was increased above the optimum for amylase activity, inhibition of amylase activity became marked. This inhibition was not reversed by subsequent cooling and dilution or by the application of a pressure of 5,500 pounds per square inch. It is suggested that the effects of quinine and urethane on salivary amylase are due to a catalysis of the spontaneous, apparently irreversible inactivation.

Schneyer, Leon H., 1954. COLLECTION OF SEPARATE SUBMAXILLARY AND SUBLINGUAL SALIVAS IN MAN. *Jour. Dental Res.*, 33 (5): 683-684.

"Systematic investigation of salivary constituents and of the process of salivary secretion in man requires the collection of separate salivary fractions. Until the present time it has not been possible, with any degree of convenience, to collect the submaxillary and sublingual secretions separately, even though mixing of the secretions due to anatomic relationships is relatively rare. Pickerill devised an appliance (segregator) for the collection of mixed submaxillary-sublingual saliva. It is the purpose of this report to describe a modification of the Pickerill appliance which permits collection of separate submaxillary and sublingual fractions. The new method involves (1) making an alginate impression of the teeth and floor of the mouth, (2) pouring a stone model, (3) blocking out on the model of the area of the plica sublingualis and of the orifices of the submaxillary ducts with base-plate wax to a height of several millimeters, and (4) making a cold-cured acrylic appliance to cover these blocked-out areas. Small-gauge plastic tubing is led from each of the three wax-filled acrylic chambers. After the acrylic has polymerized, the wax is removed. A separate impression and appliance must be made for each subject. With the appliance in place in the mouth, secretion pressure causes the flow of the sublingual saliva from the two lateral chambers and of submaxillary saliva from the medial chamber. Quantitative analysis of the salivas for endogenous and externally added materials indicates that no leakage of any significance occurs from chamber to chamber." (Author's abstract)

Schneyer, Leon H., and F. Turner, 1954a. THE SODIUM AND POTASSIUM CONCENTRATION OF "RESTING" SALIVA FROM INDIVIDUAL GLAND PAIRS IN MAN. *Jour. Dental Res.*, 33 (5): 716.

A report is made of the Na and the K concentration in human submaxillary, sublingual, and parotid salivas as determined with a flame spectrophotometer. Salivary samples were obtained from a group of 14 males, 20 to 30 years of age.

The arithmetic mean of the Na concentration, expressed in mEq /l. of saliva, determined for the various types of saliva are as follows: total mixed saliva, 7; submaxillary, 4; sublingual 15.0; and parotid, 6. Similar findings in regard to K concentrations are as follows: total mixed saliva, 17; submaxillary, 19; sublingual, 19; and parotid, 20.

Schneyer, Leon H., and L. K. Levin, 1954b. THE RATE OF FLOW OF "RESTING" SALIVA FROM INDIVIDUAL GLAND PAIRS IN MAN. *Jour. Dental Res.*, 33 (5): 716-717.

Salivary secretion, under conditions of minimal sensory stimulation, was measured in 15 healthy males, 20 to 30 years of age. Mixed saliva was collected by means of a saliva ejector, parotid saliva by use of a Lashley cup, and separate submaxillary and sublingual salivas by means of a submaxillary-sublingual saliva segregator.

The arithmetic mean of volume flow in ml. saliva /minute for the different types of saliva are as follows: total mixed saliva, 0.70; submaxillary, 0.29; sublingual, 0.016; and parotid, 0.19. The submaxillaries thus appear to produce about 41% of the resting saliva, the parotids 26% and the sublinguals 2%. It is suggested that the remaining 31% may be attributed to buccal secretion in man. (From author's abstract)

Schneyer, Leon H., 1955. METHOD FOR THE COLLECTION OF SEPARATE SUBMAXILLARY AND SUBLINGUAL SALIVAS IN MAN. *Jour. Dental Res.*, 34 (2): 257-261.

The description, construction, and method of use are given for an acrylic appliance, constructed for each donor, which permits separate, routine, collection of submaxillary and of sublingual salivas. Tests of the device showed significant chemical and physical differences in sublingual submaxillary and parotid salivas. Determination of the viscosity of acetic acid-stimulated samples from a single donor, by means of a modified Ostwald viscosimeter at 30°C, show values in centipoises of 2.9 for total mixed saliva, 1.5 for parotid saliva, 3.4 for submaxillary saliva, and 13.4 for sublingual saliva. Further tests of the "Segregator" device have shown that the rate of secretion from the sublingual gland is apparently about 4% that from the submaxillary gland.

Schneyer, Leon H., and L. K. Levin, 1955a. RATE OF SECRETION BY INDIVIDUAL SALIVARY GLAND PAIRS IN MAN UNDER TWO CONDITIONS OF STIMULATION. *Jour. Dental Res.*, 34 (5): 725.

The rate of human salivary secretion was determined simultaneously or in closely consecutive order for the submaxillary, sublingual and parotid gland pairs, either in the "resting" state or after lingual stimulation with dilute acetic acid. Use was made of the salivary "segregator" for the separate collection of submaxillary and sublingual salivas.

Under "resting" conditions in 23 subjects, the submaxillary glands contribute approximately 70% of the "fraction total" (from the 3 major pairs of glands) salivation, the parotids 25%, and the sublinguals 5%. Under acetic acid-stimulation conditions in 16 subjects, the submaxillary glands secrete approximately 63% of the fraction total salivation, the parotids 34%, and the sublinguals 2.8%. The fraction total makes

up about 55% of the total mixed saliva. The remaining 45% possibly is largely derived from small mucosal glands.

Schneyer, Leon H., W. Pigman, L. Hanahan, and R. W. Gilmore, 1956. Rate of flow of human parotid, sublingual, and submaxillary secretions during sleep. *Jour. Dental Res.*, 35 (1): 109-114.

Determinations were made of the rate of salivation from the parotid, as well as the submaxillary and sublingual glands of 3 subjects during periods of natural sleep lasting from 30 to 75 minutes. Data from 7 such measurements show no parotid salivation during sleep; the rate of parotid flow in these individuals under "resting" conditions varied from 0.03 to 0.12 cc./minute. The rate of flow of sublingual and of submaxillary saliva collected from the paired glands of one fasting subject were determined under various test conditions. No or little (0.003 cc./min.) flow was detected from the sublingual glands during natural sleep; after awakening and returning to sleep the rate varied from 0 to 0.004 cc./min. The rate immediately after final awakening varied from 0.005 to 0.007 cc./min.; under "resting" conditions the rate varied from 0.007 to 0.017 cc./min. Submaxillary flow was 0.01 cc./min. during the first period of sleep, and 0.02 to 0.07 during the second period; in the waking state immediately following the period of sleep the rate was 0.06 - 0.07 cc./minute. Under "resting" conditions submaxillary flow was markedly higher, 0.19 to 0.26 cc./minute. The Lashley cup, used to collect parotid saliva, did not hinder the subject from falling asleep; some difficulty was reported with use of a "segregator" appliance used to collect the submaxillary and sublingual saliva. Results indicate that the parotid gland does not secrete spontaneously and suggests a similar conclusion for the submaxillary and sublingual glands. So-called "resting" saliva is actually stimulated or activated saliva. Differences in biochemical characteristics of "resting" and "activated" saliva, as well as gross variations in "resting" salivation rates are attributable to variations in stimulation.

Schneyer, L. H., 1956a. COAGULATION OF SALIVARY MUROID BY FREEZING AND THAWING OF SALIVA. *Proc. Soc. exper. Biol. Med.*, 91 (4): 565-569.

Freezing and thawing of more than 200 samples of chemically-untreated, total mixed, submaxillary and sublingual salivas, collected from more than 40 subjects, produced a clot which persisted after thawing of the sample. Duplicate acetic acid mucin-clot tests of frozen-thawed and untreated aliquots of salivary samples, as well as similar duplicate determinations of sialic acid concentration and of viscosity, all indicate the clot to be derived from the salivary muroid. No clot formation was observed on freezing of parotid saliva samples. No appreciable change in the amylase activity of salivary samples from 5 subjects was effected by the freezing-thawing procedure or by removal of the clot thus formed.

Scholander, P. F., 1942. MICROGASOMETRIC DETERMINATION OF NITROGEN IN BLOOD AND SALIVA. *Rev. scient. Instruments*, 13 (8): 362-364.

A method is presented for the 5 to 10 minute determination of nitrogen in 40 mm³ of blood, saliva, or other fluids, with an accuracy of 0.02 ml.N/100 ml. of sample. The apparatus consists primarily of a micrometer burette, a bulbed capillary-extraction tube, containing mercury and alkaline hydrosulfite, which is vacuum extracted before the introduction of the test liquid, and a mercury trap to seal the micrometer-extraction joint. The size of the bubble remaining after the nitrogen has been extracted is measured by the micrometer or by a millimeter scale, and the nitrogen content is determined from the readings.

Scholander, P. F., and G. A. Edwards, 1942a. NITROGEN CLEARANCE FROM THE BLOOD AND SALIVA BY OXYGEN BREATHING. *Amer. Jour. Physiol.*, 137 (4): 715-716.

The nitrogen clearance from human blood and saliva during a period of breathing pure tank oxygen was determined by a micro-gasometric technique described elsewhere (cf. Scholander, 1942n). Samples of finger blood and sublingual saliva were taken and analyzed at frequent intervals before, during, and after oxygen breathing while subjects were in the resting position. Results are based on examination of 4 subjects.

Samples of normal blood and saliva contained an average of 1.02 volume per cent nitrogen, with a range from 0.97 to 1.05 vol. %. Nitrogen was eliminated rapidly during the period of oxygen breathing. 80-90% of the nitrogen was cleared within the first 10 min. The remaining 10-20% was gradually eliminated during the next 50 min., after which the oxygen mask was removed. At the end of 1 hr. the nitrogen content of the blood and the saliva had reached 0.06 vol. %.

When subjects breathed air again after the removal of the mask, the nitrogen in blood and saliva usually showed a transitory rise above normal. The rate of resaturation of blood and saliva with nitrogen from the air was almost as rapid as the rate of desaturation during oxygen breathing, both processes occurring within 10 min.

Schulman, Eli H., and Hamilton B. G. Robinson, 1947. SALIVARY CITRATE CONTENT IN PATIENTS WITH AND WITHOUT EROSION. *Jour. dental Res.*, 26 (6): 452.

"Small quantities of citrate have been reported in saliva and McClure and Ruzicka ([*Jour. dental Res.*], 25: 1, 1946) demonstrated that feeding citrate containing fluid to rats resulted in erosion-like dental lesions. An examination of 1345 freshmen at Ohio State University showed 28 cases (2%) of dental erosion. By method of Deysher and Holm, saliva from 15 of these students was studied: 4 showed zero to traces of citrate, 2 from 0.2-0.6 mg/100 cc., 3 from 0.6-0.9 mg/100 cc., 1.2-1.5 mg/100 cc. Of 25 individuals without erosion, 9 had 0-traces of salivary citrate, 4 had 0.4-1.0 mg/100 cc., 5 had 1.0-1.35 mg/100 cc. and 7 had 1.35-1.55 mg/100 cc. All saliva was paraffin stimulated and 100 cc. was collected at a time. Although there was no significant quantitative difference between salivary citrate in individuals with and without erosion there is no evidence presented to show that erosion was active at the time of collection of saliva and no studies were made to ascertain whether there was a protective factor against citrate in the saliva or teeth of those having relatively high salivary

citrate concentration and no erosion." (Complete paper.)

Schultz, Frederic W., and M. R. Ziegler, 1926. A QUANTITATIVE METHOD FOR THE DETERMINATION OF THE COMBINED UREA AND AMMONIA NITROGEN OF SALIVA. *Amer. Jour. Dis. Child.* 31 (4): 520-521.

A method of determining the amount of combined urea and ammonia nitrogen in filtered, unstimulated saliva is described. The determinations are made immediately after collection. One cc. of the filtered saliva is treated with Folin's buffer and urease solutions and heated for five min. at 40-55°C. The amount of ammonia evolved and collected in a dilute HCl solution is determined colorimetrically by use of Nessler's solution.

The urea nitrogen in the salivas of 9 normal subjects was found to range from 7 to 16 mg./100 cc. of saliva tested by means of this method. The urea nitrogen in the salivas of 6 hospital patients was found to range from 27 to 46 mg./100 cc. of saliva.

Schultz-Haudt, S., M. Dewar, and B. G. Bibby, 1953. Effects of hyaluronidase on human gingival epithelium. *Science*, 117 (3050): 653-654.

A description is given of changes in the epithelial and connective tissues resulting from introduction of a hyaluronidase solution (150 TR.U./cc. in distilled water delivered at a 12 TR.U./minute rate) into the gingival crevice of 36 individuals. Biopsy and histological examination of both normal and inflamed tissue showed a consistent increase in the glycoprotein content of the epithelium to follow a few hours of hyaluronidase treatment. Treatment of less than 1 1/2 days showed apparently unaffected epithelium, although dilated vessels and an appearance of loosening of the typical connective tissue structure indicated an effect in the subjacent tissues. Treatment for periods longer than 1 1/2 days showed, in 8 of 9 tests, alteration in the epithelium through solution or destruction of cell bridges and intercellular substance. Changes in staining characteristics and substantial increase in polysaccharide material of the tissue were also noted. It is suggested that various hyaluronidase-like products of gingival bacteria may produce similar gingival changes and thus contribute to gingivitis.

Schultz-Haudt, Stig, M. A. Bruce, and B. G. Bibby, 1953a. BACTERIAL FACTORS IN NONSPECIFIC GINGIVITIS. *Jour. dent. Res.*, 32 (5): 681.

A large increase in the number of fusiform bacteria, spirochetes, and vibrios was noted in stained smears from 25 patients with nonspecific gingivitis as compared with smears from clinically normal patients. The increase was greatest in the gingival crevice. Evidence of bacterial invasion of the deeper gingival tissues was noted in 1 out of 10 biopsy specimens. Hyaluronidase and an unidentified factor were present in all cases of generalized chronic gingivitis.

Schwartz, Abraham, and James H. Shaw, 1953. THE EFFECT OF SELECTIVE DESALIVATION OF THE INCIDENCE OF DENTAL CARIES IN THE WHITE RAT. *Jour. Dental Res.*, 32 (5): 682.

"Surgical removal of the major salivary glands (parotid, submaxillary, and major sublingual as well as the extraorbital lacrimal glands) of white rats fed a cariogenic diet caused production of severe caries in eight to twelve weeks. To determine whether relative degrees of caries could be obtained by extirpation of single pairs of glands, or of combinations of pairs of glands, two experiments were designed in which such operations were performed on 200 white rats. Removal of the parotids or the submaxillary glands resulted in caries scores which were significantly greater than for the unoperated control animals, but which were significantly less than for the completely desalivated animals. Removal of the extraorbital lacrimal or the major sublingual glands resulted in no significant increase or barely significant increases in caries as compared to the control rats. Elimination of the major salivary glands on one side produced caries scores on that side significantly greater than on the intact side. The total caries score for rats from which the major salivary glands on one side were removed was significantly greater than in the control animals, but significantly less than in completely desalivated rats. In groups of rats where combinations of two pairs of salivary glands were removed, the resulting caries scores were not uniformly greater than scores when only one of the two pairs was removed. Possibly this could be partially explained by significant increases in both the absolute gland weights and the ration of the weight of the remaining glands to the body weight as compared to the controls." (Authors' abstract)

Schwartz, Abraham, and J. H. Shaw, 1955. STUDIES ON THE EFFECT OF SELECTIVE DESALIVATION ON THE DENTAL CARIES INCIDENCE OF ALBINO RATS. *Jour. Dental Res.*, 34 (2): 239-247.

The effects of partial and of complete desalivation on incidence of dental caries was studied in 2 series of experiments on caries-resistant, Sprague-Dawley albino rats. No significant increase in caries activity was noted either in intact and sham-operated controls or on the intact side of rats subjected to unilateral extirpation of submaxillary and parotid glands; a significant increase in incidence of caries was noted on the operated side. An increase in incidence varying from barely significant to highly significant was noted in animals in which combinations of submaxillaries and sublinguals, parotids and submaxillaries, or parotids and sublinguals were removed. Loss of submaxillary or parotid glands seriously impaired caries resistance with the parotids being the more important in this respect. Caries activity was greatest in completely desalivated rats.

Schwarz, Carl, 1924. BEITRÄGE ZUR PHYSIOLOGIE DER VERDAUUNG. DIE H-IONENKONZENTRATION IM SPEICHEL EINIGER HAUSTIERE [Contribution to the physiology of digestion. III. Hydrogen ion concentration in the saliva of certain domestic animals]. *Pflüger's Arch. ges. Physiol.*, 202 (3-4): 475-477.

The salivary hydrogen ion concentration in man and in domestic animals was investigated. Ten cc. samples of saliva were collected a few hours after feeding, and measurements were carried out by the so-called gas-cell method. Results when

compared indicated that the absolute reaction of human saliva was mildly acid, while that of the herbivorous animals was mildly alkaline.

Scrivener, Charles A., Hugh I. Myers, Norman A. Moore, and Ben W. Warner, 1949. BACTERIAL ANTAGONISMS AND DENTAL CARIES. Jour. dental Res., 28 (6): 634-635.

"In an earlier publication Schantz and Scrivener reported that the rate of dissolution of tooth fragments in saliva from caries-resistant persons was greater than that from active caries saliva. This result was contrary to what was expected and preliminary evidence indicated antibiosis could be the explanation. The present work was initiated to confirm the previous data and gather additional proof, if possible for the antibiosis hypothesis. Ten dentin fragments were weighed and with the proper media and bacteria placed in a sample bottle and incubated. Suitable additional weighings were recorded. To establish the curve of weight loss for tooth fragments, a series of experiments were performed using tooth fragments and distilled water. It was found that, although variable, the weight loss was greatest initially and then became more gradual. Variation between bottles containing tooth fragments from the same tooth was less than that for bottles with fragments of different teeth. Five control experiments showed a weight loss. In the attempt to reisolate from saliva an unnamed streptobacillus reported in the earlier publication, an organism with some of the same characteristics was found. This organism did not prevent tooth fragment weight loss in nutrient broth, but in nutrient broth, tooth fragments, lactobacillus, and yeast, it caused a weight gain. In similar experiments with *Streptomyces griseus* and yeast, and *Streptomyces lavendulae* a similar weight gain was recorded. Thus some additional evidence was obtained concerning the antibiosis involved in the caries process." (Complete paper.)

Scrivener, Charles A., Hugh I. Myers, Norman A. Moore, and Ben W. Warner, 1949a. *Bacillus brevis* as a dental caries bacterial antagonist. Jour. dental Res., 28 (6): 635.

"Evidence from Schantz and Scrivener and preliminary experiments on three other bacteria gave some evidence of antibiosis as a possible factor in dental caries. This report concerns experiments on *Bacillus brevis*, *Actinomyces lavendulae* [*Streptomyces l.*], *Actinomyces griseus* [*S. g.*], and streptobacillus added to a culture of nutrient broth, tooth fragments, and lactobacillus caused a four-hour gain in weight. In comparison, several control experiments showed a loss in weight. Four additional series of experiments with broth, tooth fragments, sucrose, lactobacillus, and *B. brevis* confirmed the gain in weight. Bacteriologically *B. brevis* prevented bromocresol green agar inoculated with saliva from giving the acid reaction. *B. brevis* also prevented lactobacillus growth on tomato juice agar plates. The dialysate from the dialysis of *brevis* cultures inhibited the growth of lactobacillus on smear tomato agar plates. In the proper concentrations, sodium fluoride was found to stimulate *B. brevis* growth. Hence, *B. brevis* and some other organisms have been found to possess properties that are inhibitory to the

processes of dental caries from the standpoint of physical, chemical, and bacterial activity in vitro." (Complete paper.)

Scrivener, C. A., H. I. Myers, N. A. Moore, and B. W. Warner, 1950. HUMAN MOUTH ANTIBIOTICS. Jour. dental Res., 29 (5): 656.

"Two salivary pools were collected, one from caries-active and one from caries-resistant persons. Bacteriological Petri dish culture plates were prepared using various culture media. These media were selected to provide at least one type that would grow each major group of aerobic bacteria found in the mouth. The plates were inoculated with serial dilutions of the immune and susceptible pools and were incubated and examined at 24, 48, and 72 hours. As colonies started appearing, each that appeared different in any discernible way was transferred to the preferred media and subsequently isolated in pure culture. Thirty pure cultures were thus established; 17 from susceptible and 13 from the resistant salivas. Each of these pure cultures were tested for antibiosis against 3 strains of *L. acidophilus*. In some instances no promising antibiotic action was noted and these bacteria were discarded. A total of 14 pure cultures showing some antibiosis against *L. acidophilus* were tested farther. Each of these 14 oral test organisms were tested for antibiotic action against each other. The degree of antibiosis and the number of organisms inhibited varied greatly. Not only is it seen that antibiotic bacteria can be influential but bacteria, possessing this property, exist in the oral cavity and they probably produce different antibiotic substances." (Complete paper.)

Scrivener, C. A., H. I. Myers, N. A. Moore, and B. W. Warner, 1950a. CALCIUM DETERMINATION IN TOOTH WEIGHT GAIN AND LOSS EXPERIMENTS. Jour. Dental Res., 29 (5): 656-657.

"It was shown that tooth fragments subjected to saliva or nutrient broth containing *L. acidophilus* lost weight. When bacteria having antibiotic properties were added to nutrient broth and *L. acidophilus*, the weight loss was altered. It was decided to analyze the media colorimetrically for calcium to see if any correlation between it and weight loss occurred. Graphs showing correlation between weight and Ca loss were constructed. Antibiotic bacteria from susceptible and resistant saliva were added to sucrose broth, *L. acidophilus*, and tooth fragments. In most instances (11 out of 14) the calcium loss was essentially the same as the control graph. Three bacteria, 1 from susceptible saliva and 2 from resistant saliva showed decreased decalcification in comparison with the control. Most of the 11 antibiotic bacteria mentioned above showed a characteristic weight gain at 4 hours. Judging from these experiments it appears that the ideal antibiotic bacteria would tend not only to inhibit the *L. acidophilus* but prevent a lowering of the pH, weight loss, and decalcification. Since 1 bacteria from each of the resistant and susceptible pools showed the greatest tendency to inhibit *L. acidophilus*, it was decided to use a salivary media instead of the broth. The susceptible bacteria did not prevent the weight loss entirely but practically none of the loss was due to calcium, i.e., none apparently was escaping from the tooth fragments. The

bacteria from the immune pool showed only an erratic weight gain, or a weight loss when sucrose was added." (Authors' abstract)

Scrivener, Charles A., Hugh I. Myers, Norman A. Moore, and Ben W. Warner, 1950b. SOME ANTAGONISTIC ACTIVITY OF BACTERIA FROM THE HUMAN ORAL CAVITY. Jour. dental Res., 29 (6): 784-790.

Thirty strains of oral bacteria (from the salivas of carious and non-carious individuals) were tested for antagonistic activity against three strains of oral lactobacilli (one isolated from saliva, one Hadley 4646 strain, and one lyophilized strain) and against each other. Method is described in detail. Fifteen strains (predominantly *Bacillus subtilis* and *B. brevis*) showed complete inhibition of the salivary and lyophilized strains of lactobacilli; two of these 15 produced only partial inhibition of the Hadley strain.

The degree of inhibition when organisms secured from saliva were plotted against one another ranged from complete inability to inhibit other microbes (i.e., *B. rubricus*, *B. rufus*, or *B. mycoides corallinus* [I₁]) to complete inhibition of up to 14 strains (*B. brevis* or *B. subtilis* var. *globigii* [I₈]).

When the antagonistic bacteria were cultured with dentin fragments, the bacteria were ineffective in preventing acidogenesis as measured by dentin weight, calcium loss, and pH decrease.

Scrivener, C. A., B. W. Warner, H. I. Myers, and N. A. Moore, 1951. THE FREQUENCY OF OCCURRENCE, AND SALIVA COMPATIBILITY OF ORGANISMS FROM SALIVA ANTAGONISTIC TO SOME LACTOBACILLI. Jour. dental Res., 30 (4): 468.

"Early morning saliva from 98 dental students was collected according to the standard lactobacillus count technique. One-tenth c.c. of a 1:100, 1:1000, and 1:10,000 dilution of the thoroughly shaken saliva was pour plated in blood agar base medium. The plates were aerobically incubated 72 hours at 37° C. At this time the growth on these plates was covered with Kulp's tomato juice agar pH 6.1 heavily innoculated with Hadley lactobacillus (A.T.C.#4646). The plates were reincubated aerobically at 37° C. for 96 hours. The plates were then examined on a Quebec colony counter. In some instances, over the saliva bacterial colonies a clear halo of complete inhibition of lactobacillus growth was observed. In others, there was a ring of larger lactobacillus colonies resembling satellitism. In a few cases, a zone of large lactobacillus colonies at the complete inhibition halo periphery was observed. All the complete inhibition types that could be subcultured and representative types of the satellitism producing saliva colonies were established in pure culture, classified, tested for inhibition by cross streaking with three lactobacillus types, and tested for saliva compatibility with the agar well technique. Twenty-five of the 98 salivas showed some complete inhibition. Of these, 24 also showed seeming satellitism. In all, 89 salivas showed this latter phenomenon, and only 8 showed neither phenomenon. The number of organisms, representing 18 or more species, showing these 2 phenomena ranged from zero to 3,700,000 per c.c. saliva. Of the 25 pure cultures tested by cross-streaking, 19 showed inhibition, but no evidence of

satellitism or stimulation was found. Of the 25 pure cultures tested against 16 salivas with the well technique, 16 showed excellent compatibility and 4, poor compatibility. Five pure cultures gave insufficient growth for evaluation." (Complete paper.)

Scrivener, Charles A., Hugh I. Myers, Norman A. Moore, and Ben W. Warner, 1951a. FREQUENCY OF ORAL MICROORGANISMS THAT INFLUENCE LACTOBACILLUS GROWTH IN VITRO. Jour. dental Res., 30 (5): 665-669.

Paraffin-stimulated salivas of 98 individuals were examined for the frequency of occurrence of organisms antagonistic to some lactobacilli (A.T.C., H-4646, and one isolated from saliva). The double pour-plate method (a modification of a technique described by Waksman) was used; method is described in full. Colony counts were made by a Quebec counter.

Ninety salivas contained bacteria that in some way affected the growth of lactobacilli. 89 had colonies that stimulated lactobacillus growth (manifested by a ring of larger lactobacillus colonies resembling satellitism); 25 inhibited lactobacillus growth (manifested by clear halo zones of inhibition). In some instances, both phenomena were exhibited by the same saliva colony. The number of organisms per c.c. saliva (representing 14 species) in cases of stimulation of lactobacillus growth ranged from 0 to 3,700,000, the majority being below one million; in the salivas inhibiting growth, the organisms ranged from 10,000 to 20,000 in number.

Cross-streak cultures of 25 organisms gave similar results, with the addition that many solely stimulatory organisms of the previous test now exhibited inhibitory properties also.

Good compatibility of the oral organisms with almost all of 16 salivas was exhibited by 7 of 11 cultures when tested by the well method; 1 showed poor compatibility; 3 were too poor to evaluate.

The authors state that the two phenomena, inhibitory and stimulatory, are as yet not clearly understood, and warrant further investigation.

Scrivener, Charles A., 1952. SUPPORTING EVIDENCE THAT BACTERIAL ANTAGONISM IS A DENTAL CARIES INHIBITORY FACTOR. Jour. dental Res., 31 (4): 471-472.

"Active caries does not progress under deposits of salivary calculus. Naeslund has presented evidence that specific micro-organisms are responsible for the deposition of salivary calculus. This theory is corroborated by the more recent work of Hewitt and Bartel. A gram-positive bacillus, a gram-negative micrococcus, actinomyces and leptothrix are the organisms utilized by Bartel and found to precipitate calcium carbonate crystals from a specific culture medium. Ennever, Robinson, and Kitchin stated: 'It was noted that none of the caries-free surfaces from which actinomyces were repeatedly isolated became carious during a period of two years.' This they interpreted as supporting the concept that actinomyces are not significant of the cariogenic potential of a plague. The correlation of the above theory with that of bacterial antagonism as a caries-preventive factor, suggested that salivary calculus might be a constant source of

microorganisms antagonistic to the growth of bacteria ordinarily associated with active-carries. Our laboratory investigations using a double-pour-plate method of inoculation and oral lactobacilli as the test organism has confirmed this conjecture. Following the observation described above speculation arose concerning the cause of the green dots that frequently appear in positive Snyder's tests. It had been previously assumed that these dots were chromogenic or dense opaque bacterial colonies growing within the culture medium. Now however, we speculated that these dots were merely areas in the agar itself where the color change has been prevented owing to the influence of the organism present in the area. Pure cultures of organisms were obtained from an assortment of these green dots and were found to represent the actinomyces, yeasts, and all the morphological groups of bacteria. When heavy suspensions of these organisms were added to saliva obtained from caries-active persons, allowed to stand for a few hours, and used as the inoculum for Snyder's medium, the characteristic color change did not occur. This result is presumably caused by the destruction or inactivation of acid-producing organisms in the saliva by the antagonistic influence of the added organisms. Present efforts are concentrated upon the classification of the antagonistic organisms and a study of their growth factors." (Complete paper.)

Seccombe, Wallace, 1921. DIET IN RELATION TO ORAL HYGIENE. Jour. nation. dent. Assoc., 8 (6): 441-446.

A discussion-review is presented of the various aspects of oral hygiene; a general section is included on normal saliva.

Secker, J., 1934. THE HUMORAL CONTROL OF THE SECRETION BY THE SUBMAXILLARY GLAND OF THE CAT FOLLOWING CHORDA STIMULATION. Jour. Physiol., 81 (1): 81-92.

Submaxillary saliva was obtained in 18 cats, anesthetized with diethylbarbiturate and having the lingual nerve cut, either by electrical stimulus to the chorda of the affected gland or by intravenous injection of pilocarpine. Five cc. of the saliva, diluted with 2.5 cc. of 0.9% Na.Cl. and usually injected within 10 min. of collection, produced an immediate, brief pressor effect followed by marked depressor effect on the blood pressure. Injection of such saliva (0.5 cc., 1.0 cc.) caused no secretion by the submaxillary gland. Similar injection of the saliva, after alkaline hydrolysis, caused a slightly more prolonged pressor effect but no depressor effect on the blood pressure. The pressor effect was also accentuated and the depressor effect abolished after atropine. Tests of autogenous saliva before and after alkaline hydrolysis, as well as intravenous injection of acetylcholine bromine, indicated the active substance in the saliva to be acetylcholine or to produce the same biological effects. Administration of eserine was followed, during stimulation to the chorda, by a great increase in quantity and rate of flow of submaxillary saliva. Salivary response was also noted to injection of saliva after prior injection of eserine. It is concluded that a substance, resembling acetylcholine in its pharmacological actions, is

present in saliva produced by pilocarpine or electrical-stimulation of the chorda tympani in the cat.

Secker, J., 1934a. THE HUMORAL CONTROL OF THE SECRETION BY THE SUBMAXILLARY GLAND OF THE CAT FOLLOWING SYMPATHETIC STIMULATION. Jour. Physiol., 82 (3): 293-304.

Electrical stimulation applied to the cervical sympathetic nerve trunk in 16 cats, anesthetized with sodium diethylbarbiturate and having a severed chorda-lingual nerve, produced little or no salivary response. Intravenous injection of "nerve" saliva thus evolved produced vascular effects similar to those produced by intravenous injection of either acetylcholine or of saliva resulting from stimulation of the chorda tympani. The active substance, like acetylcholine, was inactivated by alkaline hydrolysis and its blood-pressure depressor effect abolished after atropine sulfate (20 mg./kg.). Stimulation of the cervical sympathetic nerve 15 minutes after the administration of eserine salicylate (0.3mg./kg.) produced a steady flow of saliva which stopped within 1 minute after cessation of sympathetic stimulation.

Intravenous injection of 0.15 mg. of adrenaline produced small (1 to 6 drops) salivary response which ceased with return to pre-injection blood pressure. Intravenous injection of "adrenaline" saliva produced similar results to those obtained with "nerve" saliva. A similar active substance was indicated by alkaline hydrolysis, and the effects of atropine and eserine on the salivary response to the adrenaline. Administration of ergotoxine likewise abolished response to sympathetic stimulation, although the salivary gland remained responsive to parasympathetic stimulation and to acetylcholine. The intravenous injection of 1 cc. of 5% nicotine produced a brief profuse salivary flow followed by lack of response to nerve stimulation, whereas adrenaline produced a reduced flow of saliva containing the active "cholinergic" substance under study.

Secker, J., 1936. Further observations on the secretion by the submaxillary gland of the cat following sympathetic stimulation. Jour. Physiol., 86 (1): 22-28.

A report is made of further observations in the cat of the flow of submaxillary saliva produced by stimulation of the cervical sympathetic nerve prior to and 15-20 minutes after administration of eserine (0.3 mg./kg.). Stimulation of the nerve produced a variable salivary response in the cat, smaller in extent than that produced by stimulation of the chorda. Administration of eserine produced no spontaneous salivation; 15-20 minutes after injection of eserine, similar electrical stimulation of the cervical sympathetic nerve resulted in a greatly augmented flow of saliva which ceased within 1 minute after cessation of the stimulus. Stimulation by adrenaline produced similar results to those obtained by electrical stimulus. The effect of eserine increasing salivary flow diminished gradually with repeated nerve stimulation or repeated doses of adrenaline. The increased secretory response following administration of eserine is independent of pressor changes. Repeated administration of 1 mg. doses of atropine showed the amount required to abolish the effect

of sympathetic stimulation to vary in different cats but to be considerably in excess of that required to annul chorda stimulation effects.

Sedwich, J. J., and R. E. Brawley, 1936. BACTERICIDAL ACTION OF SALIVA. I: Selection of media favorable to growth of certain organisms, to demonstrate inhibition by salivary agent. Jour. Dent. Res., 15 (5): 372.

Attempt to find solid media suitable for growth of certain species of bacteria; also to facilitate demonstration of bactericidal action of saliva, using Fleming's "well" method. Species and media finally selected as most satisfactory: (a) Lactobacillus acidophilus (Hadley's Type I); galactose whey, 1 percent agar plus horse serum, pH 6.4. (b) Staphylococcus pyogenes aureus [Micrococcus pyogenes var. aureus] (isolated at Strong Memorial Hospital); Kulp's tomato juice, 1 percent agar, pH 6.3. (c) Streptococcus hemolyticus, Beta (isolated at Strong Memorial Hospital); Savita, 1 percent agar plus horse serum, 1 percent. (d) Micrococcus lysodeikticus (Dr. Fleming's); plain agar 2 percent, pH 7.4. [Author's abstract]

Seeger, T., 1936. ÜBER MUNDTROCKENHEIT ALS VEGETATIVES SYMPTOM [Dryness of mouth as a symptom of autonomic nervous disturbance]. Klin. Wochenschr., 15 (27): 987.

Inhibition of salivary secretion is often found in neuroses of the autonomic system. Salivation is diminished and the saliva appears finely foamy, viscid, and has an increased dry residue content. Thorough salivation of dry food is retarded. The oral mucosa appears rather dry and shows frequent spots of white salivary foam; temporary or persistent xerostomia occurs in some cases.

Seelig, S. 1928. UBER BEZIEHUNGEN ZWISCHEN PAROTIS, PANKREAS, BLUTZUCKER UND DIABETES MELLITUS. [The relationship among parotid, pancreas, blood sugar, and diabetes mellitus]. Klin. Wochenschr., 7 (26): 1228-1230.

The effect of salivary glands on blood sugar of pancreatic-diabetic dogs was tested. The suppression of the parotid secretion by ligation of the salivary duct did not result in the decreasing of hyperglycemia noted after total extirpation of the pancreas, and the animals died in cachexia. When the order of the experiment was reversed and pancreatectomy followed the ligation of the duct, blood sugar values were much lower.

Seguin, P., 1948. ACTION IN VITRO DU FLUORURE DE SODIUM SUR LE LACTOBACILLUS ACIDOPHILUS MORO, AGENT DE LA CARIE DENTAIRE [The effect in vitro of sodium fluoride on Lactobacillus acidophilus Moro, agent of dental caries]. Compt. rend. de la Soc. de Biol. (Paris), 141 (23-24): 1170-1171.

Two stocks of Lactobacillus acidophilus were isolated and cultivated in 1% lactose medium. Two series of 6 tubes each containing 8 cc. of lactose with decreasing amounts of sodium fluoride (1/500, 1/1000, 1/2000, 1/4000, 1/8000, and 1/10000) as well as control sets without NaF were each seeded with 4 drops of a 24-hour lactose culture of L. acidophilus. Twenty-four-hour incubation gave identical results for the two

stocks: no development in tubes containing 1/500 to 1/4000 dilutions of NaF, feeble development in 1/8000 dilution; normal development in 1/10,000 and the controls. After heavy seeding of all tubes with the same organism, development was found normal except in those containing dilutions of 1/500, 1/1000. The author concludes that sodium fluoride dilutions of 1/500 and 1/1000 are bactericidal; those of 1/2000 and 1/4000 are bacteriostatic in the medium used.

In an experiment to test the antifermentation effect of sodium fluoride, the same series was used. The pH of non-seeded media was determined by colorimetric methods to be 6.7. The pH of a 24-hour control culture was found to be 4.0. Between these two extremes, the two stocks showed a regular drop in pH with increased dilution (5.8, 5.6, 5.4, 5.1 and 4.6). The author concludes that sodium fluoride has a marked inhibiting effect on the growth of Lactobacillus acidophilus even when greatly diluted.

Seki, M., 1940. ÜBER DIE PRECIPITATION DES AALSERUMS MIT DEM MENSCHENSPEICHEL [On the precipitation of eel serum with human saliva]. Jap. Jour. med. Sci., (7) 3 (3): 131*.

Precipitation experiments were made on eel serum (known to agglutinate human blood group O more readily than the other groups) with human saliva as antigen. When the group O saliva was of the "secretory type", a positive reaction occurred, while the "non-secretory type" produced a negative reaction. In one case, however, although the eel serum possessed a high agglutination titer for human blood O, and the saliva was of the secretory type, no positive precipitation occurred. The precipitin of eel serum appeared particularly significant since a definite absorption effect was not produced by either pig or rat blood of the various types.

Sellman, Sven, 1949. THE BUFFER VALUE OF SALIVA AND ITS RELATION TO DENTAL CARIES. Acta odontol. Scandinav., 8 (3): 244-268.

Previous findings are reviewed with respect to the pH and the buffer power of saliva, and their possible relationship to occurrence of dental caries. Precision in pH readings was obtained by use of the glass electrode for potentiometric titrations, and a Van Slyke apparatus to determine the CO₂ content of salivary samples. Determinations were made of salivary pH, CO₂, and bicarbonate, and of salivary CO₂ absorption curves. Saliva showed itself unstable due to a changeable bicarbonate/CO₂ balance. The CO₂ absorption curve was found in good agreement with a theoretically-derived curve of a mixture of bicarbonate and phosphate, the two constituents of saliva deemed the principal buffers in the normal salivary pH range; salivary proteins act as buffers at lower pH values. The increased total CO₂ content and buffer value of activated over resting saliva is attributed to an increased bicarbonate production by the gland, as stimulation has no marked effect on the salivary inorganic phosphate content. A study of titration curves, determined at pH 5 or below, of resting saliva collected from groups of caries-resistant and caries-active subjects, showed a statistically very-probable difference in potential alkalinity between the two groups. The buffering power of saliva may be a modifying factor in occurrence of dental caries,

but the degree of variation within each group does not permit use of buffer values to indicate liability to caries.

Seltsam, J. H., Frank Lanni, and J. W. Beard, 1949. INHIBITORY EFFECT OF HUMAN SALIVA ON HEMAGGLUTINATION BY INFLUENZA VIRUS A (PR8 strain) AND THE SWINE INFLUENZA VIRUS. *Jour. Immunol.*, 63 (3): 261-271.

A comparison is made between the effects of 12 human parotid and mixed (submaxillary and sublingual) salivary samples on the hemagglutination ability of influenza viruses. Variations in character were found to exist between individual salivas, but, generally, all the parotid secretions exhibited a lower inhibition titer, a lower hemagglutination titer, and a higher nitrogen content than the mixed secretions. Inhibition-hemagglutination titer ratios for mixed salivas varied from 5 to 128; thus, suggesting the presence of two factors (an inhibitor and a hemagglutinin).

Findings show that there is little or no selective absorption of the mixed hemagglutinin by red blood corpuscles, but that heparin has a specific action (depressant) on the submaxillary-sublingual salivary hemagglutinin.

Heat-effect experiments reveal that there is a progressive decrease in both the inhibitory and hemagglutinative activities of mixed salivas with heating (100°C). Unheated viruses were found to be capable of destroying the salivary inhibitor, and the heated virus showed a greater susceptibility than the unheated to inhibition. Only the mixed salivas contained an agglutinin for the chicken red blood cells.

It is concluded that submaxillary-sublingual saliva is more effective in inhibiting the hemagglutination effects of both the PR8 and swine influenza viruses; and that the salivary secretions act directly upon the viruses rather than on the red blood cells.

Semenovich, V. A., 1946. K VOPROSU O PROTEOLITICHESKOI SPOSOBNOSTI SLIUNNYKH ZHELEZ [On the question of the proteolytic capacity of salivary glands]. *Biull. eksper. Biol. i Med.*, 21 (5): 51-54.

The appearance, under special conditions of proteolytic properties in the saliva of man and dogs was studied in two series of experiments, in dogs with various food diets, and in dysenteric patients.

The dogs were first kept on a mixed diet and their saliva examined for its proteolytic capacity, then left on either a carbohydrate or a meat diet from 2 weeks to one month, after which they were changed from a carbohydrate to a meat diet or vice-versa. The carbohydrate diet was of two kinds, 500 gm. of bread a day, and water; or 500 gm. of bread, 200 gm. of potatoes, 300 mg. of cabbage and 100 gm. of oatmeal. The salivary stimuli used were either rusks, rusks dipped in milk, or rusks mixed with meat. The proteolytic properties of 0.55 cc. samples of the saliva were determined by Willstätter's method after 30 minutes at 35°C., using 0.95 cc. of 1% peptone, buffered at pH. 6.8 - 7.0.

The amount of saliva secreted by the dogs varied from 0.5 to 2 cc. in 15 min. There was no increase in its acidity. No albumin ferment activity was found in the saliva of dogs kept on

a mixed diet. The tabulated results show that the proteolytic action of the saliva appeared at the passage from the mixed diet to the meat diet and, especially, from the meat diet to the carbohydrate (on the same day or 2-4 days later). The ferment action of saliva was of a rather long duration which varied from 15 to 35 days. No correlation was found between the amount of saliva secreted and its proteolytic action. The ferment appeared in 50% alcohol, not in 97%, and disappeared after boiling of the saliva.

It could be assumed that ferments which do not normally occur in saliva would appear in certain pathological conditions; therefore the saliva of 27 patients of dysentery was tested for its proteolytic properties. In 9 cases the changes in the proteolytic activity of the saliva were studied in relation to the patients' clinical condition. The results were as follows.

At the height of an average or light dysentery infection, proteolytic action was manifested which gradually dropped to zero as the patient recovered. In 4 cases of severe infection (Shiga), the proteolytic action did not appear. Its absence is attributable to the complete depression of the reactive capacity of the organism and, consequently, of the functional condition of the salivary glands. As in the preceding tests, the ferment appeared in 50% alcohol only. Consequently, the splitting did not go beyond polypeptides.

Parallel examinations of solid residue and organic and inorganic salivary components were determined. A certain correlation was found in the gradual decrease of the dry residue of the saliva, its organic components and its proteolytic activity.

The author suggests that the appearance of proteolytic ferments in the saliva could be used as a diagnostic method. The appearance of albumin ferments, in particular, could serve as an indicator of the toxic condition of the organism.

Semernina, A. V., 1941. TORMOZHENIE I PROTESSESY VOSSTANOVLENIYA [Inhibition and the processes of restoration]. *Fiziol. Zhur. SSSR*, 30 (4): 469-471.

Study was made in the dog of the influence of differential inhibition on the processes of exhaustion and restoration of the salivary gland. The percentage of dry residue elicited by a metronome at 72 strokes/minute served as an indicator of normal secretion; an average of 0.94% was found almost constant during each day of experiment. An average increase to 1.03% was observed after application of double differential inhibitory stimulation at 120 strokes/minute, regardless of when the stimulant was applied during the experiment. The increase in the salivary dry residue is considered to indicate favorable conditions for glandular restoration processes produced by the differential stimulation which induces a state of cortical inhibition.

Serebrennikov, S. S., 1939. VLIYANIE SIL'NYKH (BOLEVYKH) RAZDRAZHENII NA RABOTU PISHCHEVARI-TEL'NOGO APPARATA. Soobshchenie III. Sliunnye zhelezy [The influence of strong (pain) stimulations on the work of the digestive system. Communication III. The salivary glands]. *Fiziol. Zhur. SSSR*, 27 (3): 316-322.

The effect of pain stimulation on submaxillary secretion was studied during 68 long-term

experiments in a fistulated dog. Salivation was evoked either by oral administration of 20 cc. of 0.2% hydrochloric acid for 30 seconds, or by subcutaneous injection of 0.5 cc. of 1% pilocarpine. A normal level of secretion was established which remained rather stable during each experiment. Pain was produced by faradic stimulation of the moistened skin of the hind legs applied during one minute; such stimulation elicited about 0.5 cc. of saliva. Results show that application of pain stimulus, immediately prior to administration of acid, markedly increases salivation over secretion evoked by acid alone. The after-effect of pain stimulation is of short duration; acid administered several minutes after pain stimulation produces no increase in salivation. Sympathetic innervation of the salivary gland apparently is not necessary to produce increased salivation after pain stimulation, as extirpation of the superior cervical ganglion produced little or no effect on the salivation. Pilocarpine secretion, its lag period, and its viscosity were examined in 15-minute samples during 1.5 hour in several experiments. After the injection, salivation started first from the normally innervated gland, and several minutes later from the denervated gland. Pain stimulation applied during pilocarpine secretion, increases the secretion; if applied at the start of the lag period before secretion, it elicits salivation by itself but does not affect the subsequent secretion. Saliva secreted after pain stimulation is very viscous in all cases. The rapid start and short after-effect of pain-stimulated salivation in both series of experiments indicate a nervous origin, although the role of humoral factors, in particular of adrenalin, cannot be categorically excluded.

Sergievskii, M. V., 1928. K VOPROSU O TORMOZHENII SEKRETSII SLIUNNYKH ZHELEZ [On the question of inhibition in the secretion of salivary glands]. *Fiziol. Zhurn. SSSR*, 11 (1-2): 123-130.

The factors conditioning inhibition of salivary secretion as well as the influence of some pharmaceutical drugs on salivary inhibition were studied in detail in the submaxillary gland of the cat. The classical method was used (Cl. Bernard, Ludwig, etc.). Details of the present study are published in "Mechanism of the action of adrenalin on the salivary glands" (Sergievskii, 1927).

If the sympathetic nerve is stimulated after the chorda by a strong faradic current, the chordal salivation is arrested. After a stimulation in reverse order, the checking of secretion is obtained only in a minority of cases, and requires greater power and higher frequency.

After simultaneous pilocarpine and sympathetic stimulation, the inhibiting effect of the sympathetic nerve is reduced; a greater frequency and a longer period of time is needed to obtain a depressor action from the sympathetic nerve. Although there is common salivary stimulation by both the pilocarpine and the sympathetic nerve, the action on the gland vessels is reverse, since pilocarpine has a vasodilating effect.

The author believes that the glandular vessels play an important part in the changes of salivary secretion, as sympathetic inhibition starts only after a change in color of the gland has revealed anaemia, and its after-effects coincide with the gradual restoration of normal blood circulation.

After repeated stimulation, increases in secretion can be produced by minimal stimuli. If the stimulation is progressively increased (between periods of rest), the secretion gradually regresses and finally stops. This is especially noticeable after sharp changes in frequency. It is difficult to obtain a doubling of secretion when pilocarpine action (0.25 cc. of a 1% solution at the start) is combined with chordal stimulation. Pilocarpine action may be explained through a change in the blood. After atropine, chordal action on the submaxillary glands is completely suppressed; it should be assumed, however, that this drug does not influence the "inhibiting" fibers of the chorda. Pilocarpine and curare (in small doses) elicit submaxillary secretion even after degeneration of the nerve endings. Thus, the inhibiting actions of the chorda and of the sympathetic nerve are both dependent on the strength of the stimulation.

The author concludes that the phenomena of inhibition originate in the stimulated glandular tissue itself and that stimulation and inhibition are not caused by nervous action only, but by the condition of the vessels and by chemical changes in the blood. The most plausible explanation of inhibition is given by Langley (1907-1908).

Seymour, R. J., 1917. THE DIASTATIC ACTION OF SALIVA IN THE HORSE. *Amer. Jour. Physiol.*, 43 (4): 577-585.

The diastatic activity of the parotid and of the submaxillary secretions, alone and mixed, was studied in the horse. A diastase (ptyalin?) was present in all samples but was extremely feeble, requiring a minimum of 5 hours for conversion of boiled starch (method described); was inactive on cellulose or sucrose; and its activity failed to be augmented by aeration, acidification, or exposure to weak alkalis. Experimentation offered no evidence of the secretion of zymogen with a subsequent conversion into ptyalin; nor was potassium sulfocyanide found in any of the saliva samples.

Shafer, W. G., P. G. Clark, D. Bixler, and J. C. Muhler, 1958. SALIVARY GLAND FUNCTION IN THE RAT., I. Flow, viscosity, and pH in the normal and duct-ligated rat. *Jour. dent. Res.*, 37 (5): 848-852.

Determinations were made of the salivary flow, viscosity, and pH of saliva stimulated by subcutaneous injection of 10 mg./kg. of pilocarpine nitrate in 25 male albino rats of 3 age groups: 26 days, 126 days, and 1 year old. Results show an increase in ml./hr flow from a mean of 1.0 at 26 days to 3.8 at 1 year; viscosity showed a drop for the same age span from 75.2 seconds to 48.0 seconds, and the pH a drop from 8.6 to 8.0. These flow and viscosity differences were significant at the 0.01 level of confidence, while pH differences were significant at the 0.001 level. Unilateral or bilateral ligation of parotid or submaxillary-sublingual salivary ducts in 33 male

albino rats, aged 75 to 85 days, produced no significant changes in salivary pH of samples collected 26 days after ligature. A significant decrease in salivary viscosity followed bilateral ligature of the submaxillary-sublingual ducts. Diminution in salivary flow was variable, dependent on the type and extent of salivary duct ligature. Extirpation of the major salivary glands in 6 male rats, aged 2 months, showed the accessory salivary glands to contribute very little saliva to the total flow, in tests conducted 2 weeks after desalivation.

Shafer, W. G., P. G. Clark, D. Bixler, and J. C. Muhler, 1958a. SALIVARY GLAND FUNCTION IN RATS. II. Effect of thyroid function on salivary flow and viscosity. *Proc. Soc. exper. Biol. Med.*, 98 (2): 245-247.

Daily subcutaneous injection of 10 ug. of sodium thyroxine in 9 male Sprague-Dawley strain rats for a 10-week period resulted in a 33% (statistically non-significant) increase in pilocarpine-activated salivation, while addition of 0.1% propylthiouracil to the stock diet of 5 others over the same period produced a significant 63% reduction in salivary flow in comparison to 4 controls. Radiothyroidectomy, effected by intraperitoneal injection of 500 uc of I^{131} in 10 of 18 male weanling rats resulted in significant decrease in salivary flow and significant increase in salivary viscosity. Subcutaneous injection of 10 ug. of sodium thyroxine daily for 9 days in the radiothyroidectomized rats restored parotid function to normal levels. In further tests rats were thyroidectomized by administration of 600 uc of I^{131} and then given either 10 ug. of sodium thyroxine daily or intramuscular injection of 10 mg. of testosterone every 3 days, or a combination of both treatments. No distinctive changes were noted after 1 week in salivary flow or viscosity between I^{131} rats receiving such therapy and those receiving no therapy. A significant increase in salivary flow was found in I^{131} animals receiving thyroxine or thyroxine plus testosterone; flow was partially restored to normal by testosterone injection. Increase in salivary viscosity tended to parallel increase in salivary flow. The effects of thyroid dysfunction on dental caries experience is discussed.

Shaner, Edward O., and R. Reed Smith, 1946. CLINICAL AND BACTERIOLOGICAL STUDIES OF THE USE OF A FLUORIDE DENTIFRICE. *Jour. dental Res.*, 25 (3): 121-126.

The effects of a fluoride-containing dentifrice on the acidogenic oral flora were studied. Paraffin-stimulated saliva samples were collected from 47 subjects and lactobacillus counts made. The subjects were divided into three groups: Group A (15 persons) was given a prophylaxis and was issued a dentifrice containing 0.1% sodium fluoride; Group B (15 persons) was similarly treated, but was given a fluoride-free dentifrice; and Group C (17 persons), a control group, was not given a prophylaxis, but received the experimental dentifrice. After four weeks, saliva samples were again collected and lactobacillus counts compared with those at the start of the experiment.

Ten of the individuals in Groups A and C which showed well-correlated counts exhibited a significant decrease in lactobacilli following use of the fluoride dentifrice; two, a slight increase; and six remained relatively unchanged. The inconsistencies of the remaining cases were attributed to the possibility of technical difficulties or lack of cooperation by the patient.

Of the well correlated counts of Group B, 4 individuals showed an increase; 1, a decrease; and 6, no significant change. The remaining counts were inconsistent.

When the experimental dentifrice was used for 15 months, no evidence of gingival irritation nor pathology could be traced to the dentifrice.

Shannon, Ira L., 1958. SODIUM AND POTASSIUM LEVELS OF HUMAN WHOLE STIMULATED SALIVA COLLECTED UNDER TWO FORMS OF STIMULATION FROM SUBJECTS IN A SELECT AGE GROUPING. *Jour. dent. Res.*, 37 (3): 391-400.

Determinations were made of salivary rate of flow, sodium, potassium, and the Na/K ratio with respect to age and sex of the saliva donors. Samples of mixed saliva, stimulated by 5 minutes of chewing one or more rubber bands, were collected at 9 A.M. The 5-minute samples in the first experiment were collected from 402 male and 60 female subjects, aged 17 to 25 years, while chewing a small (size 18) rubber band; saliva samples were collected in the second experiment from 540 male and 116 female subjects, aged 17 to 30 years, while chewing 3 large (size 32) rubber bands. Results of the first experiment show a mean 5-minute volume of 4.60 ml. for males and 2.23 ml. for females; an increase in rate of flow with age of males aged 17 to 20 years was significant, while the increase in flow with age in females was inconclusive due to insufficient sample sizes. Mean sodium and potassium levels expressed as mEq./L were respectively 13.42 and 24.35 in males, and 13.50 and 25.04 in females. A tendency to increase in sodium with age in females was significant in males aged 17 to 20; a tendency to increase in level with increase in volume was noted among males. Neither sodium nor potassium levels differed significantly with respect to sex. Potassium levels did not differ significantly with age but showed a tendency to decrease with increase in salivary flow. The Na/K ratio, showing a mean of 0.57 in males and 0.55 in females, increased significantly with age in males. The 3-rubber-band stimulation in the second experiment produced an increase in salivary volume of 75% among males (mean, 8.05) and of 92.8% among females (mean, 4.30) and showed a significant difference due to sex but not to age. Sodium levels showed significant difference with sex but not with age in the second experiment; a positive correlation was found between volume and sodium level in males. Potassium levels and the Na/K ratio also showed significant differences with respect to sex but not age; correlation between potassium and volume was negative. Correction formulas, applied to the sodium and Na/K ratio data from the first and second experiment, considerably reduced the pronounced differences in the uncorrected findings. Regression equations derived from the study are presented for correction of sodium, potassium, and Na/K values for varying saliva flow rates.

Shannon, I. L., 1958a. SODIUM AND POTASSIUM LEVELS OF SALIVA AND SALIVARY GLANDS FOLLOWING PROLONGED STIMULATION. Jour. dent. Res., 37 (5): 981.

Thirteen male subjects chewed 5 large (size 32) rubber bands for a 3-hour period, thus providing 36 5-minute mixed saliva samples. Mean volume for all subjects ranged from 7.1 to 8.7 ml., there being no systematic increase or decrease in rate of flow over the 3 hours. Mean sodium values (range 10.2-18.3 mEq./L.) tended to decrease with time of stimulation, while mean potassium values (range 20.5-24.0 mEq./L.) tended to increase as the stimulation continued. Homogenate assays were carried out on 198 submaxillary glands from Cotton rats, Wistar rats, chinchillas, and rabbits. Varying doses of pilocarpine were administered over periods of time up to 2 hours. Alterations in mean values for all treated animals when compared to controls were as follows:

	Sodium	Potassium
Cotton rats	+36.6%	-42.5%
Wistar rats	+60.4%	-47.9%
Chinchillas	+49.3%	-20.6%
Rabbits	+46.6%	-33.8%

These findings suggest that there is an abundant, readily available source of sodium for the working gland and that such is not true to the same degree for the potassium ion. Histologic studies are being carried out. (Author's abstract)

Shannon, I. L., 1958b. SALIVARY SODIUM, POTASSIUM AND CHLORIDE LEVELS IN SUBJECTS CLASSIFIED AS TO CARIES EXPERIENCE. Jour. dent. Res., 37 (3): 401-406. Abstract: Jour. dent. Res., 37 (5): 981-982.

Flame photometric and titrimetric analyses were performed on saliva samples collected from 537 selected male subjects. "Cariou" subjects presented at least 20 caries surfaces ($\bar{x}$ = 48.8) and no restorations of any type; "resistant" participants presented no carious lesions and no restorations of any type; "restored" cases had at least 20 ($\bar{x}$ = 40.6) surfaces restored with silver amalgam and had no evidence of dental caries. To qualify, the subjects were required to be free of periodontal involvement and to have at least 20 ($\bar{x}$ = 28.2) permanent teeth present. The data were analyzed to determine if significant differences existed in the levels of volume, sodium, potassium or chloride for the 3 subject groupings. No significant differences were found in volume or potassium levels. Mean sodium concentration was significantly lower ($P < .05$) for the "resistant" group than for the other 2 categories. The mean chloride value for the "resistant" group was significantly lower ($P < .05$) than the mean level for the "cariou" subjects. A similar but even more significant ($P < .01$) difference was found between the chloride means of the "resistant" and "restored" subjects. No significant differences were noted between the "cariou" and "restored" groups. There was an extensive overlap in values for individuals throughout the 3 groups. Predictability of an individual's dental status

based upon levels of these variables would be, at best, extremely low.

Shannon, I. L., and J. R. Prigmore, 1958c. PHYSIOLOGIC CHLORIDE LEVELS IN HUMAN WHOLE SALIVA. Proc. Soc. exper. Biol. Med., 97 (4): 825-828.

Determinations were made of the chloride levels in 5-minute samples of saliva collected at 9 A.M. from 323 male subjects, aged 17 to 19 years and 159 female subjects, aged 18 to 21 years; salivary flow was stimulated during the 5-minute collection period by chewing 3 large rubber bands. Similar salivary determinations were made of samples, elicited by oral movement only, of 503 male subjects aged 17 to 24 years, and 179 female subjects aged 18 to 26 years. Results show no significant differences in salivary volume or in chloride level with respect to age. The rate of flow was significantly higher in males than in females and likewise higher in both sexes, during oral movement than during rubber band stimulation. Chloride levels were significantly higher in salivary samples from both sexes stimulated by chewing rubber bands than when no exogenous stimulant was used. Salivary volume and chloride level were negatively correlated in samples collected from females without regard to stimulant, while among males, negative correlation was found in saliva stimulated by oral movement only and positive correlation in saliva stimulated by chewing rubber bands.

Sharp, A. J., 1898. NOTES OF A CASE OF XEROSTOMIA (MOUTH DRYNESS). Lancet (London), 1 (3895): 1114.

A report is given of a case of xerostomia in a 41 year-old woman which is believed to be due to a nervous disorder. Mercuric iodide in medium doses with quassia appeared to be improving the condition.

Shastin, N. R., 1930. BEZUSLOVNYE I USLOVNYE REFLEKSY PRI MIKSEDEME. Soobshchenie I [Unconditioned and conditioned reflexes in myxedema. Communication I]. Peditriia, Moskva, 14 (5): 403-409.

Parotid and, occasionally, submaxillary secretion was studied in myxedematic children by Krasnogorskii's method. Salivary secretion was stimulated in these subjects by 30 cc. of 0.5% citric acid or, in more normal cases, by food (bread, apples, chocolate, candied sour cranberry).

The unconditioned salivary reflex in cases of congenital myxedema is markedly diminished, as compared to the average reflex in normal children of corresponding ages. The reflex is stronger, in cases of lesser, non-congenital hypothyroidism, but still below that of the normal child of corresponding age. The unconditioned reflex increased after prolonged treatment with thyroxin.

The salivary flow from the mouth, observed in such cases, is due only to a failure to swallow the saliva. A consistently larger salivary response is obtained on one side than on the other, in some cases, even after acid stimulation. This is the result of habitual one-sided chewing, inducing a greater development of the ipsilateral secretory function.

Shastin, N. R., and E. N. Golikova, 1930a. K IZUCHENIIU MECHANIZMA SLIUNOOTDELENIIA PRI GLISTNYKH INVAZIIM DETEI. Soobshchenie I.

[Contribution to the study of salivary function during worm invasion in children. Communication I]. *Pediatrica, Moskva*, 14 (6): 469-482.

Comparison is made of salivary secretion in children affected by ulcerous stomatitis, myxedema, epidemic parotitis, and worms. The unconditioned salivary reflexes are relatively depressed in myxedema and almost completely depressed in epidemic parotitis; both unconditioned and spontaneous salivation are markedly increased in ulcerous stomatitis. Normal levels of salivation were established in three age-groups of children, those aged 2 to 6 years, 7 to 10 years, and 10 to 14 years. Submaxillary and parotid saliva were then collected from a group of 28 children affected with worms, three-minute samples being collected after stimulation either by 30 cc. of 0.5% citric acid or by 20 gm. of bread, apple, candied cranberry, or chocolate. A flowing saliva on the side of mastication was noted in 17 cases; this flow is not attributed to an increased unconditioned salivary reflex. The unconditioned reflex were not increased in either gland in 26 of the cases; a few cases showed a decrease, and only two cases showed an increase. The unconditioned salivary reflexes remained at the same level with minor fluctuations after deworming. The salivary response to foods in children over 10 years of age did not completely parallel responses to acid; the response to citric acid was very low, not exceeding average values for children 2 to 3 years of age.

Shastin, N. R., 1930b. O SEKRETSII OKOLOUSHNYKH I PODCHELIUSTNYKH SLIUNNYKH ZHELEZ PRI EPIDEMICHESKOM PAROTITE U DETEI [On the secretion of the parotid and submaxillary salivary glands during epidemic parotitis in children]. *Russkaiia Klinika*, 14 (9-10): 213-222.

Salivary secretion was studied in 3 children affected with epidemic parotitis. Salivary samples, stimulated by 30 cc. of 0.5% citric acid, were collected before breakfast from each gland separately during 3 minutes and determinations made of the amylase content, dry residue and organic matter. Comparison was made between the secretion of the diseased and that of the normal gland.

Tabulated results show in each case a decrease in salivary secretion during epidemic parotitis. The degree and time of maximal decrease vary. Secretion almost ceases in the first parotid gland affected; its recovery to normal function is retarded, the secretion rate remaining low even after all the clinical symptoms of parotitis have disappeared. Conditioned secretory reflexes, which existed in the normal gland, disappear completely in this gland at the onset of the disease and reappear only at the end of the second week. Restoration to normal secretion may be more rapid in the opposite parotid gland. In myxedematic children affected with parotitis, restoration to normal secretion is twice as slow as in normal children (54 days instead of 21 to 27).

The salivary amylase content decreases at the beginning of epidemic parotitis, returning to normal after the 13th day. Fluctuations in the salivary dry residue and in the organic and inorganic contents rarely exceed normal limits.

Shastin, N. R., and E. N. Golikov, 1931. SEKRETSIIA OKOLOUSHNYKH I PODCHELIUSTNYKH SLIUNNYKH ZHELEZ PRI IAZVENNOM STOMATITE U DETEI [Parotid and submaxillary salivary gland secretion during ulcerous stomatitis in children]. *Klin. Med. (Moskva)*, 9 (7-8): 366-369.

Study was made of parotid and submaxillary salivation in 2 children having ulcerous stomatitis, using the Krasnogorskii method; the pronounced ulceration was unilateral permitting bilateral comparison of the secretions. Samples were collected 30 minutes before breakfast of spontaneous saliva as well as saliva stimulated either by 30 cc. of 0.5% citric acid, 5 gm. of biscuit powder, or 20 gm. of candied cranberry; salivary alkalinity was determined colorimetrically. Spontaneous parotid salivation on the ulcerated side was 0.6-1.5 cc/3 minutes, and 0.0-0.2 cc/3 minutes on the normal side; secretion rates were practically equal after recovery. Acid-stimulated salivation on the diseased side was 4.0-6.0 cc., and 2.1-4.0 cc. on the normal side; food-stimulated salivation followed the same trend. Spontaneous submaxillary salivation on the diseased side was 1.7-2.3 cc/3 minutes, and 0.3-0.5 cc. on the normal side; this hypersecretion disappeared after recovery. Three-minute submaxillary responses to acid stimulation were 5.7 cc. on the diseased side and 4.7 cc. on the normal side. Spontaneous parotid and submaxillary salivas were pH 7.2 on the diseased side and 6.8-6.9% on the normal side; the reactions became equal, both weekly acid, after recovery.

Shaw, James H., and David Weisberger, 1949. CARIOUS LESIONS IN COTTON RAT MOLARS. II. Effect of removal of principal salivary glands. *Proc. Soc. exper. Biol. Med.*, 70 (1): 103-105.

The extirpation of the principal salivary glands of 14 cotton rats on a cariogenic diet produced a significant increase in dental caries in 12 weeks over that appearing in a control group of 11 rats on the same diet, having intact glands.

Sheinerman, M.D., 1931. RABOTA SLIUNNYKH ZHELEZ VO VREMIA PEREGREVANIIA ORGANIZMA [The work of the salivary glands during overheating of the body]. *Fiziol. Zhur. SSSR*, 14 (2-3): 301-309.

Study was made of the influence of short-breath overheating and glandular heat exhaustion on salivary secretion and its dry residue percentage in dogs. Three dogs were operated upon by the Glinskii method with submaxillary and sublingual fistulae. The experimentation room was heated to 40 or 42° R. At each experiment the dogs were given water (taken by some 3 to 4 times during one experiment, consistently refused by others); the drinking of water slightly depresses the salivary secretion.

Observations lasting 2 hours showed first an increase and, toward the end of 2 hours, a sharp drop in salivary secretion. The average amount of secretion in the same animal is, moreover, influenced by the season; in the summer it is higher [average 82 cc./2 h., according to table] with a much shorter period of latency [1.3 to 14 min.]; lower in the winter [average 54 cc./2 h., according to table], with a longer period of latency [12 to 27 min.]. The amount of saliva

secreted in a 3 minute-sample, or in 12 to 15 minutes, never reaches in the winter the quantity secreted in the summer.

Comparing the dry residue amounts of the first 5 and the last 5 heat-stimulated salivary samples, a decrease in percentage is consistently observed in the last portions; this decrease varies in degree [up to 35%]. This fact indicates that the gland is exhausted by heat.

The influence of heat conditions and exhaustion through heat on normal rusk-stimulated secretion was further studied. The dogs were fed small equal portions of rusk every 15 seconds during 9 minutes. The saliva was examined at room temperature before, and 10 to 15 minutes after the heating. Results obtained after the heating showed in nearly every case a distinct, or even sharp drop [18%] in solid residue percentage.

Simultaneous observations of the animals' body temperature revealed two types of dogs: heat-resistant (body temperature decreases slightly during overheating; heat-induced salivation is large, 90 cc./2 hr., and is usually delayed 15 to 20 minutes), and less resistant types (body temperature rises to 42°C. in about 2 hours; heat-induced salivation is small and occurs without delay).

Shekun, L. A., 1954. SEKRETORNAIA DEIATEL'NOST' SLIUNNYKH I ZHELUDOCCHNYKH ZHELEZ U SOBAK PRI PERVICHNOM I POVTORNYKH B₁-AVITAMINOSAKH [Secretory activity of the salivary and gastric glands in dogs during the first and repeated B₁ avitaminoses]. Trudy Nauch. Soveshch. po Probl. Fiziol. i Patol. Pishchevarenia, Moscow-Leningrad, 1954, p. 297-305. Abstr.: Sovet. med. refer. Obozrenie, Fiziol., 1956 (25): 96-97.

Salivary secretion was studied in dogs having a chronic fistula of the parotid gland, and gastric secretion in animals having isolated ventricle and gastroesophagotomy. Results show that the normal course of salivary secretion is disturbed to a lesser extent than the gastric secretion during the development of B₁ avitaminosis; vitamin therapy restores salivary activity quicker than gastric secretion. The gastric condition is described. Changes in the central nervous system, especially in the cortex, are considered to be the basis for the B₁ avitaminosis symptoms.

Shepard, L. A., and William J. Gies, 1916. ON THE VALIDITY OF MARSHALL'S "SALIVARY FACTOR" FOR THE BIOCHEMICAL DETERMINATION OF THE SUSCEPTIBILITY TO, OR IMMUNITY FROM DENTAL CARIES. Jour. Allied dent. Soc., 11 (2): 275-296.

The nature and possible fallacies of Marshall's salivary factor are discussed and evaluated. Experiments similar to those of Marshall, (1915) were performed by the authors which demonstrated that there are marked variations in the salivary factor when salivation is elicited by paraffin or other salivary stimulants. Filtration of the salivary samples yielded filtrates which were less acid to phenolphthalein, but had no effect on the salivary factor. No apparent nutritional states were detected as having an influence on the salivary factor.

Shepeleva, V. A., 1934. K KHARAKTERISTIKE PROTSessa, VYZYVAIUSHCHEGO IZMENENIIA SOSTAVA

SLIUNY PRI DLITEL'NOI RABOTE ZHELEZY [On the characteristics of the process inducing changes in salivary composition during prolonged glandular activity]. Fiziol. Zhur. SSSR, 17 (2): 243-251.

The effect of food saturation and of salivary gland exhaustion on the dry residue content of saliva was studied during long-termed experiments in 3 dogs. Standard feedings with rusk were conducted to determine the normal dry residue content in submaxillary and parotid saliva before and after saturation feedings. These were large portions of liquid cereal, fed rapidly to restrict salivary gland activity; the 3-7 cc. of saliva secreted during the 3-5 minute feeding was 10 to 20 times less than like salivation occurring during gland exhaustion tests. Salivary dry residue, organic matter, and ash content were determined. No substantial variation from the normal dry residue was noted in salivary samples collected during the pre-saturation test feedings. The dry residue content increased considerably during the cereal feeding, then decreased somewhat during the post-saturation feeding to remain at a higher level than that found during the pre-saturation feedings. The increase in salivary dry residue is attributed to the strong trophic influence of eating on the function of the salivary gland. Gland-exhaustion control experiments in two dogs showed respectively a 42.9% and a 49.6% drop in the salivary dry residue content of samples collected at the beginning and at the end of the experiments. Food saturation is not considered as a factor inducing a decrease in salivary dry residue; such a decrease is observed only during prolonged secretion and shows a drop in functional capacity incident to glandular exhaustion.

Sheppard, Mary S., 1935. THE BACTERICIDAL ACTION OF PURE METALS AND METAL FILLINGS. Dental Cosmos, 77 (10): 968-975.

The bactericidal properties of gold, silver, copper, mercury, amalgam and gold inlay were tested against various microorganisms. These included mixtures of bacteria obtained from saliva and tooth scrapings, Lactobacillus acidophilus, Staphylococcus aureus [Micrococcus pyogenes var. aureus], a yeast, and strains of green streptococci isolated from human mouths. Results of the experiments in which both heavily seeded culture plates (dextrose veal-infusion agar) and peptone broth were used show pure gold and silver to possess no antiseptic properties. The presence of these metals often enhancing growth of the various microorganisms. Gold inlays appeared bactericidal in plate cultures containing L. acidophilus, streptococci and mixtures of mouth organisms but not in broth suspensions except those containing L. acidophilus. The amalgams varied from strongly bactericidal to inhibitive to growth of the organisms. A few amalgam fillings appeared to enhance their growth. Pure copper and pure mercury were strongly bactericidal toward all mouth bacteria tested, and inhibited the growth of yeasts. Metal fillings are considered to exert a minor general effect on bacteria in the mouth.

Sherman, H. C., and F. Walker, 1921. THE INFLUENCE OF CERTAIN AMINO ACIDS UPON THE ENZYMIC HYDROLYSIS OF STARCH. Jour. Amer. chem. Soc., 43 (11): 2461-2469.

An investigation is presented concerning the comparative effects of asparagine, aspartic acid,

glycine, alanine, tyrosine, and phenylalanine (alone and in various combinations) on the rate of hydrolysis of starch by fresh saliva, commercial pancreatin, malt extract, commercial takadiastase, and various amylase preparations.

Sherman, H. C., and N. M. Naylor, 1922. INFLUENCE OF SOME ORGANIC COMPOUNDS UPON THE HYDROLYSIS OF STARCH BY SALIVARY AND PANCREATIC AMYLASES. Jour. Amer. chem. Soc., 44 (12): 2957-2966.

A review of the literature plus personal experimentation indicates that the action of the auxo-amylases, with the exception of the natural amino acids, in supporting hydrolysis of starch is due to the hydrogen ion or salt effects rather than to the organic structure of the compounds.

Shestopalov, N. P., 1930. VLIYANIE SOLEI KALIIA I KALTSIIA NA RABOTU SLIUNNYKH ZHELEZ [The influence of potassium and calcium salts on the functions of the salivary glands]. Fiziol. Zhurn., SSSR 13 (1): 103-113.

The influence of chlorides of potassium and calcium on pilocarpine-elicited salivary secretion was studied in two dogs with chronic fistulae of all three salivary glands. 0.4 cc. (0.21 mg./kg.) of a 1% pilocarpine solution was injected subcutaneously and samples of saliva collected every 5 min. during 2 h. 30 min. and measured. 1 cc. (5.2 mg./kg.) of a 10% aqueous solution of chloride of potassium or calcium was injected intravenously three times during the period of experimentation, at 15 min. intervals, 30 min. after the start of the experiment, when the pilocarpine curve was beginning to descend. 80 experiments were made.

Comparison of the pilocarpine secretion curve with the two others shows a decrease in salivation after simultaneous injection of CaCl_2 and pilocarpine beginning immediately after the injection. The injection of KCl showed in one dog almost the same effect as CaCl_2 ; in the other, however, after a decrease of secretion as in the first dog, there was an increase in salivation in the second phase of the experiment. These discrepancies may have been the result of a constitutional difference in the two dogs.

Shiere, Frederic R., C. E. Georgi, and R. L. Ireland, 1951. A STUDY OF STREPTOCOCCUS SALIVARIUS AND ITS RELATIONSHIP TO THE DENTAL CARIES PROCESS. Jour. dent. Res., 30 (1): 116-125.

A quantitative study was made of occurrence of *Streptococcus salivarius* in the paraffin-stimulated saliva of 114 adults and children and correlated with the salivary pH and DMF (decayed, missing and filled teeth) of the subjects. Results indicated that *Str. salivarius* is associated with dental caries; the average pH was 7.6.

Thirty-eight organisms isolated from the saliva were cultured on a selective medium and their identity as *Str. salivarius* was confirmed. Each isolated culture was found to be gram-positive and composed of long and short chains of cocci. Biochemical reactions of the isolates showed that they could readily convert some common sugars to lactic acid; final pH determinations were found to be between 4.0 and 5.0.

Incubation of freshly extracted teeth in carbohydrate solutions inoculated with *Str. salivarius* showed etching of the enamel to take place. The addition of 1 ppm. of sodium fluoride to the medium inhibited the action of *Str. salivarius*.

It is concluded that *Str. salivarius* may be considered a potential etiologic agent of dental caries.

Shiota, T., and M. F. Kunkel, Jr., 1958. EFFECTS OF GLUCOSE, LACTATE, AND pH ON CERTAIN BACTERIAL AND CHEMICAL CHANGES IN INCUBATED SALIVA. Jour. dent. Res., 37 (1): 51-52.

The effects of glucose, sodium lactate, and pH on certain bacterial and chemical changes in incubated pooled saliva were studied. The saliva pool was divided into 6 lots. Glucose was added to lots 1 and 2 to make 0.2 and 0.5 per cent final concentrations, respectively. Lots 3 and 4 received sodium lactate to make final concentrations of 0.2 and 0.5 per cent, respectively. The pH of lot 5 was adjusted to 6.5, whereas lot 6 was not altered (pH 7.7). Upon incubation, the unaltered saliva supported the growth of fusobacteria, but not lactobacilli, streptococci, or *Veillonella*. The addition of glucose increased the lactobacillus populations, whereas the pH 6.5, pH 7.70, and the lactate added lots showed no such increase. Glucose brought about a rapid decline in the fusiforms in contrast to the other treatments. The streptococci increased with the addition of glucose, whereas the addition of lactate and the lowered pH maintained the streptococci for a longer period than the unaltered (pH 7.7) saliva. The *Veillonella* increased rapidly in the presence of glucose or sodium lactate. The ammonia and indole formation was inhibited completely by both concentrations of glucose and, to a slight extent, by 0.5 per cent sodium lactate. The total nitrogen of the pooled saliva was 700 $\mu\text{g}/\text{ml}$., free ammonia nitrogen 125 $\mu\text{g}/\text{ml}$., carbohydrate as glucose, 215 $\mu\text{g}/\text{ml}$., and the dry weight, 7 mg./ml. (Author's abstract)

Shiota, T., and M. F. Kunkel, Jr., 1958a. IN VITRO CHEMICAL AND BACTERIAL CHANGES IN SALIVA. Jour. dent. Res., 37 (5): 780-787.

Changes in population numbers of lactobacilli, streptococci, *Veillonella* sp., and fusiform oral bacteria was determined in portions of pooled paraffin-stimulated saliva incubated at 37°C. for 54 hours under various conditions. Portions of the saliva, collected from 7 individuals, were treated to provide 0.2% and 0.5% salivary glucose solutions, 0.2% and 0.5% sodium lactate solutions, as well as pH levels of 6.5 and (normal) 7.7. Results show that addition of glucose stimulated a great increase in numbers of lactobacilli, other factors producing no significant differences. Fusiform bacilli declined rapidly in numbers on addition of glucose in contrast to other treatments. Streptococci also increased with addition of glucose, while drop in pH or addition of lactate maintained the population for a larger period than unaltered pH 7.7 saliva. *Veillonella* sp. increased in numbers in saliva with added sodium lactate and to a lesser extent with added glucose. The results also showed that addition of glucose markedly inhibited the formation of ammonia and indole during incubation.

Shipman, S. J., and A. G. Foord, 1922. A POSSIBLE MODE OF TRANSMISSION OF INFECTION IN TUBERCULOSIS. *Amer. Rev. Tuberculosis*, 6 (7): 566-570.

The possibility of transfer of tubercle bacilli [*Mycobacterium tuberculosis*] through an intermediary, non-tuberculous person was studied in 5 married couples (husband tuberculous, wife non-tuberculous). In the morning, before cleansing the mouth, the husbands kissed their wives and then both "kissed" sterile petri dishes. The wives repeated this process after 15 and 30 minutes. A physiological saline solution wash from the petri dishes was injected intraperitoneally into guinea pigs and was also used to seed Petroff's media. Transfer of the bacilli to the guinea pigs, via the non-tuberculous wives, was demonstrated (two cases inoculated from first petri dishes, one from a 15-minute petri dish).

In another experimental series, *Bacillus prodigiosus* [*Serratia marcescens*] in saline was sprayed into the mouths of husbands. The bacillus was identified in cultures prepared from petri dishes and potatoes infected by the wives.

Shirokova, K. I., 1941. FUNKTSIIA SLIUNNYKH I ZHELUDOCHNYKH ZHELEZ PRI DISENTERII [The function of the salivary and gastric glands during dysentery]. *Ark. biol. Nauk, Leningrad*, 62 (3): 20-24.

Parotid and gastric gland function was studied in a group of 75 dysentery patients aged from 16 to 45 years. Salivary tests were made at the height of the disease, during convalescence, and at discharge from the hospital. Determinations were made of the lag period, amount of salivation and its ureate content in samples collected from the capped duct after oral stimulation by 25 cc. of 2% citric acid, administered at a rate of 5 cc./minute during 5 minutes, twice within 30 minutes. A marked to complete inhibition of salivation was noted during the height of the disease, which lasted 5 to 10 days in light cases, 10 to 15 days in moderately severe cases. The lag period persisted from 20 to 25 minutes, and 40 to 50 mg.% of salivary ureate was found in the scanty samples. A 5 to 10-fold increase over normal secretion was found during convalescence, amounting to 20 cc. in 30 minutes; the salivary ureate content dropped. The secretion rate dropped to a normal of 3 cc in 30 minutes at the time of discharge. These findings differed in 25 more severe cases which showed protracted stages of salivary inhibition and hypersecretion. Gastric secretory function generally paralleled the salivary, except in the 25 cases with protracted salivary disturbances.

Shklair, I. L., H. R. Englander, and L. M. Stein, 1954. THE EFFECT OF COMPLETE MOUTH REHABILITATION ON THE SALIVARY LACTOBACILLUS COUNT. *Jour. Dental Res.*, 33 (5): 717.

Salivary lactobacillus counts were made in a group of 47 naval trainees, aged 17 to 21 years, prior to, and bimonthly for 4 months after restoration or removal of carious teeth. An initial drop to 500 or less colonies ml. was noted in 80% of the cases, many of these becoming negative. A 65% to 98% drop from the pre-treatment count

were found in the remaining cases. Most of the cases showed the reduced count to persist for 2 or 3 months after clinical treatment before increasing to a level less than that found before treatment.

Shklair, I. L., H. R. Englander, and H. H. Chauncey, 1958. FLOW RATE AND LACTATE FROM THE CONTINUOUSLY STIMULATED HUMAN PAROTID. *Jour. dent. Res.*, 37 (1): 29-30.

Four successive samples of parotid saliva were collected for 5 minutes from each of 36 male naval recruits (average age 18 years) by means of stimulation with 2 sticks of gum. The sampling technic was as follows: (1) the initial 5-minute collection was made, (2) the second sample was collected after 30 minutes (subject chewed 2 fresh sticks of gum every 5 minutes during the interval between collections), (3) the third sample was collected 60 minutes after the start of the experiment (continuous chewing and changing), (4) the subject was given a 15-minute rest period, and (5) a fourth 5-minute sample was obtained immediately after the 15-minute recovery period. The volume of parotid saliva collected at each time interval was measured and the lactic acid concentration was determined for the 5-minute volume. The mean flow rates per 5 minutes at zero time, 30 minutes, 60 minutes, and after a 15-minute rest period were 4.2 ml., 3.4 ml., 3.3 ml., and 4.5 ml. of parotid saliva. The mean lactic acid concentrations were, respectively, 19.5, 24.3, 23.7, and 22.5 meg. per ml. of parotid saliva. It appeared that the rate of secretion tended to diminish after continuous stimulation. This fatigue effect on the gland occurred concomitantly with the accumulation of lactic acid in the parenchyma and the excretion of increasing amounts of lactic acid. However, the gland was able to recover after a brief rest period. (Author's abstract)

Shockley, Thomas E., C. I. Randles, and M. C. Dodd, 1956. THE FERMENTATION OF SORBITOL BY CERTAIN ACIDOGENIC ORAL MICROORGANISMS. *Jour. dent. Res.*, 35 (2): 233-240.

In the study of sorbitol fermentation of oral organisms a new carbohydrate-free culture medium was developed. "Smooth" (S) and "rough" (R) strains of lactobacilli, isolated from the paraffin-stimulated salivas of caries-immune and caries-susceptible individuals, were incubated for 48 hours in the new medium. None of the 11 R strains fermented sorbitol added to the medium; they fermented glucose only very weakly. The 19 S strains fermented both substances; none of the 30 strains fermented glycerol. Studies of pH changes in a trypticase-yeast extract broth medium showed glucose to reach pH 5.0 in 12-24 hours with S strains of lactobacilli, in 6 hours with streptococci. The lactobacilli showed little activity with sorbitol while streptococci produced a pH of 5.0 in the sorbitol in 12 hours. Tests of S and R strains in the new medium showed incubation for 48 hours to produce a pH of 5.0 in glucose with 4 of 11 R strains and 17 of the 19 S strains; with sorbitol no R strains and only 5 of the S strains reached pH 5.0. Serial transfers of lactobacilli in the presence of sorbitol failed to yield organisms capable of greater acid production from sorbitol;

those not fermenting sorbitol produced no fermenters after 8 such transfers.

The effects on salivary pH and flora produced by addition of 1% solutions of sorbitol, glucose, or glycerol to 14 salivary samples was studied. The addition of glucose caused a drop in pH to 4.8 after 12 hours incubation and to 4.6 after 24 hours incubation. Growth of streptococci, favored early in the incubation, was followed after 24 hours by growth of lactobacilli and disappearance of the streptococci. The addition of glycerol was followed by a rise in pH and growth of gram-negative rods; proteolytic activity was indicated. Addition of sorbitol was followed by a slow drop in pH to 5.7 after 48 hours incubation of the second transfer; large numbers of gram-negative rods and cocci were present and, in most samples, gram-positive rods and cocci. In another experiment results of 3 successive transfers in sorbitol-saliva showed a predominance of gram-negative rods; plating a 1/1000 dilution on sorbitol medium showed only gram-negative, proteolytic rods. Further metabolic studies using strains of lactobacilli showed acid production to be weak and to occur only near a neutral pH and in the absence of glucose.

Shortt, H. E., and B. N. Lahiri, 1934. MORPHOLOGICAL STUDIES ON RABIES. I. The salivary glands. Indian Jour. med. Res., 21 (3): 587-604.

Histological studies of the salivary glands of humans, monkeys, and dogs revealed that certain characteristic appearances occur in these structures under conditions of rabies infection. The pre-symptomatic, early symptomatic, and advanced symptomatic stages were examined and in each case there were notable staining reactions. The demonstrable inclusions were concluded to be reactions of the glands to over-stimulation (infection), and in no instance could the bodies be detected as being morphologically distinct structures of organisms.

A discussion of the various stains employed is included with suggested preferable techniques and stains.

Shulman, Eli H., and Hamilton B. G. Robinson, 1947. SALIVARY CITRATE CONTENT IN PATIENTS WITH AND WITHOUT EROSION. Jour. Dental Res., 26 (6): 452.

Small quantities of citrate have been reported in saliva and McClure and Ruzicka (Jour. Dental Res., 25:1, 1946) demonstrated that feeding citrate containing fluid to rats resulted in erosion-like dental lesions. An examination of 1345 freshmen at Ohio State University showed 28 cases (2%) of dental erosion. By method of Deysher and Holm, saliva from 15 of these students was studied: 4 showed zero to traces of citrate, 2 from 0.2-0.6 mg/100 cc., 3 from 0.6-0.9 mg/100 cc., 1.2-1.5 mg/100 cc. Of 25 individuals without erosion, 9 had 0-traces of salivary citrate, 4 had 0.4-1.0 mg/100 cc., 5 had 1.0-1.35 mg/100 cc. and 7 had 1.35-1.55 mg/100 cc. All saliva was paraffin stimulated and 100 cc. was collected at a time. Although there was no significant quantitative difference between salivary citrate in individuals with and without erosion there is no evidence presented to show that erosion was active at the time of collection of saliva and no studies were made to ascertain whether there was a

protective factor against citrate in the saliva or teeth of those having relatively high salivary citrate concentration and no erosion.

Shulman, Eli H., and Hamilton B. G. Robinson, 1948. SALIVARY CITRATE CONTENT AND EROSION OF THE TEETH. Jour. dental Res., 27 (4): 541-544.

Paraffin-stimulated saliva (100 cc.) was collected from each of 40 young adults (25 without dental erosion and 15 with erosion); citrate determinations were made. The pentabromacetone test of Perlman, Larly and Johnson was employed to ascertain the presence of citrate; a modification of the method of Deysher and Holm was utilized for quantitative salivary measurements.

In the group without dental erosion, analyses showed:

9 samples (36%) - - no citrate to trace amounts
4 samples (16%) - - 0.4 to 1.0 mg. per 100 cc.
5 samples (20%) - - 1.0 to 1.35 mg. per 100 cc.
7 samples (28%) - - 1.35 to 1.55 mg. per 100 cc.

In the group having dental erosion, analyses showed:

4 samples (26%) - - no citrate to trace amounts
2 samples (13%) - - 0.2 to 0.6 mg. per 100 cc.
3 samples (20%) - - 0.6 to 0.9 mg. per 100 cc.
3 samples (20%) - - 0.9 to 1.2 mg. per 100 cc.
3 samples (20%) - - 1.2 to 1.5 mg. per 100 cc.

No correlation could be established between the salivary citrate content and the presence of caries.

Sicard, J. A., and --- Dopter, 1905. CYTOLOGIE DU LIQUIDE PAROTIDIEN AU COURS DES OREILLONS. [Cytology of parotid fluid in mumps]. Compt. rend. Soc. Biol. (Paris), 58 (7): 317-318.

A report is made of various changes noted in the parotid saliva of 19 persons suffering with mumps.

Sierakowski, S., and F. Milejowska, 1924n. CAPACITÉ DE NEUTRALISATION DES ACIDES ET DES BASES PAR LES MILIEUX BACTÉRIENS ET PAR LES LIQUIDES PHYSIOLOGIQUES [Capacity of bacterial culture media and physiological fluids to neutralize acids and bases]. Compt. rend. de la Soc. de Biol. (Paris), 90 (10): 704-706.

The buffering power of various substances used in bacterial media and of various physiological fluids was tested by colorimetric methods. The buffering power of saliva was found to be very feeble.

Sievers, Olof, 1934. ÜBER DEN GEHALT DES SPEICHEL AN SOG. "BLUTGRUPPENFERMENT" [The so-called blood group enzyme content of the saliva]. Klin. Wochenschr., 13 (46): 1640-1641.

Daily fluctuations of the salivary blood group enzyme content was examined in a group of subjects. Salivary samples were taken from each individual on fasting, after cleaning the oral cavity, and after breakfast. The samples were tested as natural saliva, and after being boiled for 30 minutes. Then 5% starchy solution, and the next day 0.25 cc. tincture of iodine (diluted hundred times) were added to the samples. Results indicated that the enzymic action was more active in saliva collected after breakfast. In the next experiment decreasing amounts of diluted animal anti-serum was added to human blood

group A samples. This time a considerable decrease in the enzymic activity prevailed. The absence of the enzyme after breakfast suggested the testing of its fluctuations during the course of the day. After meals the blood group enzyme was either completely missing in the saliva or considerably reduced. When subjects belonging to blood groups O or B were tested similar fluctuations were seen in the enzymic content. In summing up the results it was seen that the strongest enzymic activity prevailed in the fasting saliva. It was also characteristic that the enzyme was present in all salivary samples examined, even when its action was not noticeable.

Sievers, Olof, 1935. UEBER DIE EIGENSCHAFTEN DES "BLUTGRUPPENFERMENTS" IM SPEICHEL [On the properties of the "blood group enzyme" in saliva]. Zeitschr. f. Immunitätsforsch., 86 (1-2): 130-146.

"1) A broth containing blood-group enzyme maintains its destructive properties [for blood-group specific substances] at least a month at room temperature, provided that the broth was incubated at 37° C. the first 24 hours. If an enzyme-containing broth is kept in the incubator (37° C.) for several days, the blood-group enzyme is destroyed. When an enzyme-containing broth is stored at room temperature during the first few days it is possible to transfer blood-group enzyme to fresh broth in the same fashion as earlier transfers. This, however, is not possible if the broth was stored for several days at room temperature. In spite of this the original broth retains its property to destroy A-substance in saliva as well as in Witte's peptone.

"2) A transfer from broth to broth gives a negative result if one adds a small amount of chloroform simultaneously with the enzyme-containing broth to the new broth flasks. The blood-group enzyme, however, which is contained in the first broth flask and is transmitted, remains active against the A-substance even when mixed with chloroform.

"3) The results of the tests attempting to store broth containing blood-group enzyme at room temperature, as well as the tests with chloroform, seem to indicate the existence of an agent capable of being cultured outside the organism, and that this agent forms a blood-group enzyme which then has a destructive action on blood group properties.

"4) The transmission of this active principle from broth to broth is not dependent on the type of the person, A, B, or O, from which the saliva was obtained.

"5) The addition of broth not only is highly active in destroying its own A-substance, but also in destroying the A-substance in other heated enzyme-free saliva of an A-person.

"6) Various anaerobic bacteria isolated from the mouth cavity exhibited as little a destructive influence on the A-substance as previously studied aerobic bacteria. By emulsifying the colonies grown on various plates with saline or broth, one obtains an emulsion which destroys the A-substance of Witte's peptone, provided that the colonies were grown under anaerobic conditions (Fortner plates). If the Fortner plates were exposed to oxygen of the air for 6-8

hours, after the bacteria had been incubated at 37° for 24 hours, the emulsions of these colonies exhibited no enzymic properties." (Author's summary, translation.)

Simeone, F. A., and J. P. Maes, 1939. SENSITIZATION OF THE SUBMAXILLARY GLAND BY SYMPATHETIC DENERVATION. Amer. Jour. Physiol., 125 (4): 674-679.

The effects of sympathetic denervation on the responses of the submaxillary gland of 10 cats to adrenaline, acetylcholine, pilocarpine, and cocaine were studied.

One submaxillary gland was denervated by excision of the superior cervical ganglion. Forty-seven to ninety days later, under urethane anesthesia, both adrenals were ligated and the other superior cervical ganglion excised or blocked.

Eight cats with normal innervation were tested for comparability of right and left gland response to injections of adrenaline. Similar response was observed in 6 of the 8, while the remaining 2 showed less than a 10% difference. Administration of adrenaline to the 10 denervated cats resulted in a 50% increased response by the earlier denervated gland over the newly-cut, control gland in 6 cats; a 20% increase in 2; while no difference could be detected in the remaining 2.

When tested with acetylcholine, 3 of the 10 cats gave more than a 50% increase in secretion by the sensitized gland over the control gland; 4 showed a 15% to 30% increase; 3 gave equal response.

The effect of pilocarpine was tested in 7 cats. The sensitized gland in 6 responded with a 100% or more increase over the control gland. The 7th showing no difference had also given equal response to adrenaline and acetylcholine.

The effect of cocaine was tested in 3 cats. No effect was detected when cocaine was used alone. When used in combination with pilocarpine it produced a nearly equal flow by increasing the responsiveness of the control gland.

It is suggested that the effects of denervation are exerted directly on the secretory cells.

Simmons, Norman S., 1941. THE EXISTENCE OF A PAROTID SALIVARY MUCINASE? Jour. dental Res., 20 (3): 255-256.

"Acid production studies on saliva using the differential volumeter (Fenn) technique, without added substrate shows that an insoluble substrate can be removed from the saliva, and has been shown to be the mucin. A plateau is reached early in the acid production in saliva, filtered after standing during which time practically all the mucin flocculates, and on the addition of purified mucinate, the acid production is resumed. Unfiltered saliva shows a steady rate of acid production. This may be due to the liberation of the acid radicals of the prosthetic group or by fermentation of its carbohydrate components on enzymatic hydrolysis. Evidence has been found for the existence of an enzyme in saliva, probably in the parotid secretion, capable of eliciting a series of reactions with salivary mucin, which have been used as the criteria for the existence of other mucinases. In addition to the rapid depolymerization of the mucin as reflected in the viscosity and precipitability changes in dilute acetic acid, a secondary and slower hydrolysis of its [prosthetic] group follows as evidenced by the

liberation of reducing substances. The agent is non-dialyzable, thermolabile, and is inhibited by iodine and mercurial salts, but not by toluene, thymol, CHCl_3 or NaF in low concentrations." (Complete paper.)

Simmons, Norman S., 1942. SALIVARY SECRETIONS FROM DIFFERENT DUCTS OF THE CAT. Jour. dental Res., 21 (3): 324.

"All 6 [salivary] ducts of cats were resected and the secretions collected separately after pilocarpine stimulation. Secretion of the oral mucosa was collected from a pool in the oral cavity. Adult cats were used and secretions collected for 1/2 hour. Average secretion rate was as follows: submaxillary--11.7 cc., parotid--2.8 cc., sublingual--0.20 cc., oral mucosa--4.5 cc. The oral mucosa secreted approximately the same volume as both parotids. Submaxillary gland secretion was approximately 4 times that of parotid and 60 times that of sublingual. Viscosity of the secretions were: parotid--1.16, submaxillary 3.04, relative to water as 1. Secretions of sublingual gland and mucosa are not homogeneous and viscosity cannot be measured as secreted. However, on removal of large clumps of mucin, remainder gives relative viscosity of from 50-100. On incubation submaxillary and parotid secretions show no change in viscosity. Mucosal secretion shows loss of viscosity at very rapid rate (from 50 down to 5 in 45 minutes and remains at 2 after 3 hours). Parotid saliva causes no change in viscosity of submaxillary saliva. Mixed saliva shows change in precipitation as found in human saliva on incubation. This also parallels viscosity loss. Mucin of mucosal secretion gives same precipitation characteristics as does that of sublingual. Submaxillary mucin is soluble in 1 per cent acetic acid." (Complete paper.)

Simmons, Norman S., 1948. STUDIES ON SALIVARY MUCOPOLYSACCHARIDES. Jour. dental Res., 27 (6): 738.

"As part of the study of the salivary polysaccharide of the submaxillary gland of the pig was isolated and purified. This material is shown to react with large molecular weight proteins to give an insoluble precipitate or clot (depending on salt concentration) at pH levels below their isoelectric points. Thus, with globulins or globins insoluble mucin salts are formed at slightly acid pH levels whereas basic protamines give insoluble mucin salts at pH levels of 7.0 and above. This suggests that the insoluble mucin fractions of human saliva may be salts of mucopolysaccharides with basic proteins, possible of the histone type. The high viscosity of the mucopolysaccharides is further raised by the presence of proteins when the pH of the solution is as or slightly below their isoelectric points, indicating the presence of soluble polysaccharide-protein salts of extremely large molecular configuration. In such cases, high enough viscosities are achieved to produce thixotropic gels." (Complete paper.)

Simmons, Norman S., 1949. STUDIES ON SALIVARY MUCOPOLYSACCHARIDES: LYSOZYME-POLYSACCHARIDE COMPLEX. Jour. dental Res., 28 (6): 640.

"Submaxillary mucopolysaccharide (pig) forms salts with proteins below their isoelectric

points. The molecular configuration of these complexes depends upon (1) pH, (2) protein-polysaccharide concentration, and (3) salt. Since lysozyme (egg white) is a basic protein (isoelectric pH 10.5 to 11) the possibility of its forming a complex with submaxillary mucopolysaccharide at the pH level of saliva was investigated. With relatively high concentration of lysozyme a typical mucopolysaccharide-protein clot is formed at low pH levels. At near neutral pH this complex is evidenced by turbidity changes and gelation. The complex is altered at increasing salt levels. With low salt the activity of lysozyme is completely inhibited by the mucopolysaccharide at salivary pH levels. This effect is also diminished with increasing salt concentrations." (Complete paper.)

Simmons, Norman S., 1951. STUDIES ON THE DEFENSE MECHANISMS OF THE MOUTH. Jour. dental Res., 30 (4): 494.

"Egg white lysozyme forms insoluble salts with acidic mucopolysaccharides at the pH values found in saliva. If one of the antibacterial factors in saliva is similar to egg white lysozyme, the possibility exists that it may complex with the contained salivary mucins and be removed from saliva as an insoluble salt. To test this possibility the mucins were precipitated from whole saliva (with a quaternary ammonium salt) and the supernatant fluid tested for lytic activity against the test organisms *Sarcinae luteae*. The precipitation of the mucins resulted in a 5- to 10-fold increase in lytic activity of the supernatant saliva as against the control untreated saliva. Saliva previously centrifuged and the quaternary ammonium salt added to the supernatant showed no increase in activity. It may be concluded then that one of the salivary bacteriolytic agents is in salt complex with the contained mucins and can be displaced by a quaternary ammonium salt." (Complete paper.)

Simmons, Norman S., 1952. STUDIES ON THE DEFENSE MECHANISMS OF THE MUCOUS MEMBRANES WITH PARTICULAR REFERENCE TO THE ORAL CAVITY. Oral Surg., 5 (5): 513-526.

An extensive review of the literature on the defense mechanisms of saliva and the oral mucous membranes against microbes is presented.

"It can be seen from the experiments described that submaxillary mucoid can inhibit the activity of egg white lysozyme against the test organisms, *Micrococcus lysodeikticus*. This inhibition is probably a non-specific one, being the result of the formation of a mucoid-lysozyme salt which is removed from solution by precipitation. The inhibition can be reversed to a considerable degree by the addition of sodium chloride. This reversal effect is probably due to the dissociation of the mucoid-lysozyme complex by the neutral salt. The inhibition of lysozyme activity by submaxillary mucoid is greatest at low pH (3.5 and 4.5); at the higher pH levels of 5.5 and 6.8, there was some slight activity, particularly after long incubation periods. This may possibly be a result of the dissociating effect that higher pH levels would have on the mucoid-lysozyme complex.

"It was also shown that the lytic activity of whole saliva is greater than that of centrifuged saliva against *Micrococcus lysodeikticus*. This

is probably a result of the lytic agent being sedimented with the insoluble mucins of the saliva. Quaternary ammonium salts such as 'Octab' and 'Cetab' are excellent reagents for the precipitation of submaxillary mucoid as well as other acid mucopolysaccharides. When these reagents were used to precipitate the mucins from saliva, the lytic activity of the supernatant saliva was increased from five- to tenfold. The addition of 'Cetab' to centrifuged saliva, from which the mucin and much of the lytic activity is sedimented, did not increase the lytic activity of the supernatant fluid. This would tend to support the concept that the lytic agent in saliva is in complex with another constituent of the saliva, probably a mucoid or mucopolysaccharide." (Author's summary.)

Sinitiro, Utita, 1940. ÜBER DIE AUSSCHIEDUNG VON "AUSSCHIEDERTYPUS" UND "NICHTAUSSCHIEDERTYPUS" DES MENSCHENSPEICHELs ALLER VIER GRUPPEN DURCH DIE HEMMUNG DER HÄMAGGLUTINATION DES IMMUNHÜHNER- ODER IMMUNENTENSERUMS DEM MENSCHENBLUT GEGENÜBER [On the differentiation of the "secretory" and "non-secretory" types of human saliva of all four groups by inhibition of hemagglutination of chicken or duck sera immunized against human blood]. Jap Jour. med. Sci. (7) 3 (3): 127*-128*.

Human saliva was differentiated into two types--secretory and non-secretory--depending on whether or not the saliva inhibited the agglutination of human blood corpuscles (group O) with immune chicken or duck sera. Findings with groups A, B, and AB agreed with the inhibitory effects on group-specific agglutination.

Sitaramamurti, A., 1941. ERYTHROPOIETIC FACTOR IN HUMAN MIXED SALIVA. Indian med. Gaz., 76: 349-350.

Mixed fresh human saliva was examined for the presence of a haemopoietic factor. After standardizing the test animals (pigeons) according to their reticulocyte count and weight, each animal received an injection of 3 cc. fresh saliva intramuscularly twice a day for 3 days. The reticulocyte counts before and after saliva injection were compared. Before the saliva injections, the counts averaged 8 to 9.5% in peripheral blood and 1 to 1.5% in bone marrow. After the injections, the reticulocyte counts of the blood showed an average increase of 3.5 to 4%; after 7-8 days, of 17-19%. A similar rise (1 to 4%) in the reticulocyte count in bone marrow was also observed. A further change was an increase both in the normoblasts and in the haemogenetic centers of the bone marrow. The author considers this as indicative of the presence of a haemopoietic factor in saliva.

Skarzynska-Gutowska, Marie, 1928. ACTION PHYSIOLOGIQUE DE LA VITAMINE B. PHÉNOMÈNES DE SÉCRÉTION DE QUELQUES GLANDES [The physiological effect of vitamin B. Secretion phenomena of some glands]. Compt. rend. de la Soc. de Biol. (Paris), 99 (28): 1168-1169.

Experiments on dogs indicate that extracts containing vitamin "B", injected intravenously, produced no secretion of saliva, whereas stimulation of the chorda tympani "in the same case" did. It is concluded that the secretory innervation of the submaxillary gland is not affected by the extract.

Skliarov, I. A. P., 1937. IZMENENIĖ VELICHINY PARNOGO BEZUSLOVNOGO REFLEKSA POD VLIĖNIEM CHASTICHNOI ANESTESII SLIZISTOI OBOLOCHKI POLOSTI RTA [Changes in the value of the bilateral unconditioned reflex under the influence of partial anesthesia of the mouth mucosa]. Exper. Med., Kharkov, 3: 77-81.

Comparative study was made of the parotid secretion after cocaineization of one side of the mouth in a dog with bilateral fistulation of Stensen's ducts; 2 gm. of rusk powder was used as a stimulant.

It was observed that the stimulant, placed on the front of the tongue, was distributed evenly in the mouth and elicited a nearly equal symmetrical salivation; if the stimulant was placed on one side of the mouth, a greater secretion was elicited from the ipsilateral than from the opposite gland.

One side of the mouth and tongue was then rubbed with a 10% cocaine hydrochloride solution, and the stimulant placed on the front of the tongue. If the bilateral parotid secretions were close to equal before cocaineization, the secretory rate on the anesthetized side now decreased considerably, [up to half of its original value].

The author concludes that the value of the unconditioned salivary reflex depends on the stimulation capacity of the receptor surface. The unconditioned stimulation does not travel through the central part of the reflex arc to the other side, and does not influence the secretion of the other gland.

Skliarov, I. A. P., 1953. O VLIĖNII PEREREZKI ĖAZYCHNYKH NERVOV NO VELICHINU REFLEKSOV OKOLOUSHNYKH ZHELEZ [On the effect of resection of the lingual nerve on the values of reflexes in the parotid glands]. Voprosy Fiziol., 3: 17-22.

Study was made of conditioned and unconditioned parotid salivation before and after resection of the right lingual nerve in dogs having bilateral parotid fistulas. A meat-rusk powder was used as a salivary stimulant. The powder applied to the front of the tongue, to effect stimulation of the whole mucosa, elicited a nearly equal bilateral salivation from the normally-innervated glands, while unilateral stimulation of the buccal mucosa sharply increased secretion ipsilateral to the stimulation. Nerve resection was followed by a period of slight but continuous secretion from the partially-denervated gland. No marked change was noted in the unconditioned or conditioned reflexes for 20 to 30 days after nerve resection; the natural conditioned reflex became very weak thereafter on the-operated side. Frontal stimulation of the tongue evoked bilaterally unequal salivation, while unilateral stimulation produced no significant increase in salivation if applied ipsilateral to the nerve resection and only slight secretion if applied heterolaterally. The unconditioned reflex is considered to be maintained initially at a normal level to a large extent, after nerve resection, by participation in the response of a natural conditioned reflex until its ultimate extinction on the operated side.

Sktrofskii, E. V., L. I. Makhlinovskii, and M. M. Slutskai, 1937. LIZOZIM I INGBIN V SLĖNE CHELOVEKA [Lysozyme and inhibine in human saliva]. Ann. Mechnikov. Inst., 6 (1): 91-96.

Study was made of the action of salivary lysozyme and of inhibin on several microbes of the mouth flora and the role of these substances in mouth infections. The lysozyme content was determined in 460 samples of human saliva. The saliva was filtered, diluted in physiological solution at 1:10, 1:100, 1:1000, 1:10000, and emulsion of 750 million cells Micrococcus lysodeikticus.

Samples of 1:10 salivary dilution from 336 patients showed the presence of lysozyme in 95 to 98% of the cases, from diseased as well as from healthy mouths; the lysozyme content in healthy mouths is, however, some-what higher. Salivary tests from maxillary osteomyelitis patients showed a maximal lysozyme content in the stage of closed abcess. After the breaking of the abcess and during convalescence the lysozyme titer is usually lower: 4, (complete lysis) 4, 1, 0, (no lysis) (in the above salivary dilutions) before the breaking of the abcess. 2, 1, 0, 0, then 0, 0, 0, 0, and during convalescence, 3, 2, 1, 0, then 2, 2, 0, 0. The lysozyme titer in mouths with healthy mucosa, examined over a period of 20 days, was fairly constant.

The bacteriolytic property of lysozyme was tested in undiluted filtered saliva to which cultures of streptococci, staphylococci or acidophilic bacillus, isolated from the mouth, were added. Bacterial lysis was observed after 3 h. of incubation in the majority of salivary samples; a few samples, however, remained inactive.

The inhibin content was determined in 76 salivary samples by Dold's method. Dold's "salivary" agar showed either absence of bacterial growth or a growth delayed for several days.

Results of these observations were in complete conformity with Dold's findings. The inhibin content of saliva in healthy or diseased mouths fluctuates considerably. Parallel tests of salivary lysozyme and inhibin showed a coincidence in titers only in 50% of the cases which confirms Dold's idea of the difference in nature of these substances.

No parallel between the lysozyme or inhibin content of saliva and the nature of disease could be established.

Slanetz, L. W., and Ethan Allen Brown, 1946. STUDIES OF THE EFFECT OF GLYCERITE OF HYDROGEN PEROXIDE UPON THE NUMBERS OF ORAL MICROORGANISMS. Jour. dental Res., 25 (4): 223-230.

The effect of application of glycerite of hydrogen peroxide on the oral microbes was studied. The method, a modification of the brushing and rinsing method of Bryan [cf. Bryan (A), 1936] is described in full. Organisms were cultured on tryptose-glucose agar.

Saliva samples were collected from each of 6 subjects twice weekly for three weeks at various times before and after applications of the solution. Bacteriological examinations of the teeth and gingival crevice were also made. An average reduction in the total bacterial count, ranging from 26 to 93%, was observed at the end of three weeks. In fusiform bacteria alone, there was a 52 to 93% reduction. Controls, using sterile water, showed no reduction. Dark-field examination of gingival crevice scrapings

of experimental subjects showed a marked reduction in fusiform bacteria and in oral spirochetes (i.e. they disappeared in all cases within one to two hours after application, and very few were observed after six hours).

After determination of the normal microbial flora of 11 healthy persons, 6 began brushing their teeth twice daily with a 1.5% glycerite of hydrogen peroxide solution, 3 dissolved penicillin lozenges (1000 units) three times daily, 1 rinsed his mouth with 10 ml. undiluted Listerine, and 1 control continued his usual brushing habits. Samples were collected at 11:00 a.m. daily. A comparison of the bacterial counts before and after applications showed a percentage decrease from 11.3 to 79.1% for glycerite of hydrogen peroxide, and from 40.6 to 96.7% for penicillin. The decrease effected by Listerine (0.1%) was not significant. Darkfield microscopy indicated a marked reduction of spirochetes and fusiform bacteria by glycerite of hydrogen peroxide and penicillin.

The mouth and throat were rinsed at 10:00, 11:00, 12:00, and 1:00 p.m. with 10 ml. of glycerite of hydrogen peroxide to determine the effect of repeated applications of the solution on oral flora. Samples, collected at 10:30, 11:30, 12:30, 1:30, 2, and 3 p.m. indicated a continuous gradual decrease, the largest occurring 1/2 hour after the last treatment. One to two hours after the last application, a gradual increase began.

The possibility that such a reduction may be due to the mechanical brushing and rinsing process was eliminated since control tests, run with sterile water, showed no reduction in bacterial counts.

Slanetz, L. W., and E. A. Brown, 1948. METHODS FOR ESTIMATING THE NUMBER OF BACTERIA IN THE MOUTH AND THE ACTION OF DISINFECTANTS ON THE ORAL FLORA. Bacteriol. Proc., 1 (1): 31.

"The comparative efficiency of different sampling methods and media for the estimation of the number of bacteria in the mouth of human beings was determined. The collection of saliva samples by the paraffin-chewing technique resulted in much higher counts than when samples were collected by a brushing and rinsing procedure. Counts on saliva collected over a 3-minute period were as representative as counts made on samples obtained during shorter or longer collection periods. Samples collected at 10 different periods of the day indicated that the greatest number of bacteria was present several hours after eating. Tryptone glucose blood agar was found most suitable for the estimation of total counts and counts of alphahemolytic streptococci. A tomato juice-peptone agar adjusted to pH 5.0 was satisfactory for lactobacilli counts. A glycerite of hydrogen peroxide solution (0.75, 0.5 and 0.37 percent) and Cepacol generally produced a continual reduction in the oral flora when used twice daily as a mouth rinse. However, large numbers of bacteria usually persisted when these disinfectants were employed. Penicillin produced a very marked reduction in the number of bacteria normally found in the mouth. When 1 penicillin troche (5,000 units) was dissolved in the mouth after each meal, the total number of bacteria developing on blood agar and the alpha hemolytic streptococci was reduced from 97.6 to 99.9 percent

and the number of lactobacilli from 56 to 94 percent."

Slanetz, L. W., and Ethan Allen Brown, 1949. STUDIES ON THE NUMBERS OF BACTERIA IN THE MOUTH AND THEIR REDUCTION BY THE USE OF ORAL ANTISEPTICS. *Jour. dental Res.*, 28 (3): 313-323.

Quantitative estimations of the oral bacterial flora of 2 to 3 individuals were made; the effect of several oral antiseptics upon their numbers was noted.

Saliva samples, either paraffin-stimulated for various periods of time or obtained by a brushing and rinsing technic [cf. Slanetz, 1946], were collected at 10 different periods during the day. Tryptose glucose blood agar was found to be the most suitable medium for the growth of the majority of bacteria; lactobacilli were cultured on tomato juice agar (pH 5.0).

An average of eight series of tests over a one-month period showed that the largest numbers of bacteria occurred in the oral cavity at 7:00 a.m. (approximately 225 million) and at 12:00 noon (approximately 194 million). The numbers generally were lowered within 1 hour after each meal, decreasing to approximately 87.5 million after breakfast, to 56 million after lunch, and to less than 50 million after dinner. At 11:00 p.m., the bacterial count had risen to approximately 112.5 million.

The bactericidal action of glycerite of hydrogen peroxide, Cepacol (cetyl pyridinium chloride), and penicillin troches was studied using 16 subjects between 17-45 years of age. Six subjects rinsed their mouths with 10 ml. glycerite of hydrogen peroxide for 1 minute after their morning and evening brushing of teeth; 5 used undiluted Cepacol in a similar manner; and 5 dissolved a penicillin troche (5000 units) after each of their three daily meals.

A comparison of saliva samples, collected daily at 10:00 a.m. for 5-day periods before, during, and after application showed that a definite reduction of all bacteria was effected by the test antiseptics. A continual reduction in the oral flora was produced by glycerite of hydrogen peroxide (0.75 per cent, 0.5 per cent, and 0.37 per cent) and Cepacol. The most significant reduction was produced by the penicillin troches, which caused an average 84% reduction in lactobacilli and a 99% decrease in streptococci. No diminution in oral bacteria was observed in one individual who received one penicillin troche (5000 units) daily at 11:00 p.m. for 5 days.

It was noted that an increase in yeasts and Gram-negative organisms frequently accompanied penicillin treatment, but no further investigations were made.

Smith, Geoffrey, H. 1930. FACTORS AFFECTING THE DEPOSITION OF DENTAL CALCULUS. *Australian Jour. exper. Bio. and med. Sci.*, 7: 45-77.

A series of investigations are presented in an attempt to discover more of the factors involved in the cause and formation of dental caries, and with particular emphasis upon the precipitation of calcium phosphate by the chemical effects of saliva and the oral environment. The various theories of calculus formation are discussed and some are investigated; it is evidenced that CO₂

loss, diet effects on the pH of saliva, and changes in the amount of organic phosphate are not the primary potentiators of caries formation but may be contributing factors. The most feasible theory and the one most emphasized by Smith is the phosphatase theory which definitely indicates that the phosphatase of desquamated cells is able to convert organic phosphate (also glycerophosphate) into free phosphate which would then be available for incorporation into plaques or caries. The optimal pH for this hydrolytic reaction was shown to be around 5.5.

No relationship was found to exist between changes in food intake or urinary pH, and day to day variations in salivary pH; it is suggested that the pH of saliva does not change appreciably under normal conditions to favorably affect the process of calculus formation.

Besides describing a method for the estimation of the amount salivary phosphatase, it is indicated that the amount of phosphatase varies in different individuals depending upon the physiological and pathological condition of the mouth at the time samples are obtained. Also described is a method for the in vitro precipitation of calcium phosphate in the epithelial layer of gingival mucosa, but attempts to demonstrate depositions of inorganic phosphate in mucous membranes taken directly from the oral cavity led only to negative results.

Smith, H. Carlton, 1922. CONCENTRATION OF HYDROGEN IONS IN SALIVA, AND SOME RECENT METHODS OF SALIVARY ANALYSIS. *Jour. dental Res.*, 4 (1): v-x.

Determinations were made of the hydrogen ion concentration of saliva. The importance of pH to bacteria and oral tissues is emphasized. The author found that the pH of normal saliva is approximately 7.25; that of blood, 7.33; and that of saliva in the presence of prevalent tartar, 7.4 to 7.6.

In studying the role of proteins in tartar formation, the author refers to a paper by Jacques Loeb (*Science*, 52 (1350): 449-456) in which it was demonstrated that gelatin can combine with neither cation or anion of an electrolyte at a pH of 4.7; at a pH greater than 4.7, it can combine with cations only, and at less than 4.7, with anions. The author investigated the idea that this might be true of salivary proteins. Dialyzed saliva (slightly acid with a pH of 6.8, due to the acid properties of salivary proteins) was shaken with calcium carbonate and centrifuged. The supernatant fluid was completely neutral; it was presumed that the calcium had combined with acid protein. The neutralized saliva was divided into two portions and sodium bicarbonate and sodium acid phosphate were added to one part until the pH was 7.6. A freshly extracted tooth was placed in each of these portions and was removed and weighed after 4 days. The tooth in the neutral saliva weighed exactly same after as before the 4 days, (to the tenth of the mg.); the tooth in basic solution had gained 5 mg.

Miscellaneous observations included: (1) the electrical conductivity of pyorrheal saliva ("0.0016 to 0.0090") is higher than that of typical caries ("0.0005 to 0.0029").

(2) The hypobromite method for the determination of urea in urine is not accurate for saliva.

(3) Urea, usually occurring to the extent of 9-14 mg./100 cc., is increased to 50-60 mg./100 cc. of saliva in nephritis cases.

(4) Uric acid, when determined by Dr. Folin's phosphotungstic acid method, is usually present.

(5) Attention is called to the three types of acidities found in saliva: (a) temporary acidity (or that believed due to CO_2 and removable by boiling), (b) permanent (that in which the presence of lactic acid is suggested and in which prolonged boiling does not affect the acidity), and (c) progressive acidity (acidity which progresses with boiling, possible due to calcium present combining with phosphoric acid and held in solution by colloidal protein, whereby extensive boiling separates basic CaPO_4 from the combination).

Smolelis, J. Murphy, 1945. THE EFFECTS OF TIME AND TEMPERATURE ON THE GROWTH OF *LACTOBACILLUS ACIDOPHILUS* IN SALIVA. Jour. Dental Res., 24 (3/4): 201-202.

"Saliva was collected from 25 students. One cc. from each sample was mixed with 9 cc. of dextrose broth and 0.1 of the mixture inoculated on tomato-juice agar according to Hadley's method. A second aliquot was incubated for 24 hours before mixing with broth. The third was held 96 hours at room temperature before mixing and plating. The fourth aliquot was held for 48 hours at 8° C. At the end of a 5-day incubation period the cultures held for 24 hours at 37° C. showed slightly more than twice the number of *L. acidophilus* organisms per cc., and those samples that were held 96 hours at room temperature showed an average increase of 27 times the number of organisms found in aliquot A. The fourth aliquot held at 8° showed a decrease in number of organisms per cc. when compared to the initial culture. The quantitative variation of organisms under the 4 conditions to which the samples A, B, C, and D were subjected was not a constant one in all cases." (Authors' abstract)

Smorodinzew, J. A., and Fr. E. A. Iliin, 1927. ZUR FRAGE NACH DEM EINFLUSS DER ARSEN UND ANTIMONVERBINDUNGEN AUF DIE FERMENTATIVEN FUNKTIONEN DES ORGANISMUS. IV. Die Ursache des hemmenden Einflusses von Brech Weinstein auf die Speichelamylase. [The effect of arsenic and antimony compounds on the enzymatic function of the organism. IV. The cause of the inhibitory effect of tartar emetic on salivary amylase]. Biochem. Zeitschr., 185 (4-6): 328-333.

Electrometric and colorimetric potential hydrogen determinations were made with different mixtures at temperatures ranging from 13° to 20° C. These mixtures contained in turn 0.1% to 0.05% starch solution, active and inactive (heated) diluted saliva, and various concentrations of tartar emetic. Tabulated results indicated that the active reaction was more of an alkaline nature after colorimetric than after electrometric determination. The inhibitory effect of the tartar emetic on the amylase was due to an increased acid reaction of the mixture and the pH of the decomposed mixture reached the optimum acid value.

In the buffer medium tartar emetic had neither an accelerating nor an inhibitory effect on the decomposition of starches conditioned by salivary amylase. No changes were seen in pH

values of the medium either in the presence or absence of a buffer and tartar emetic. The active reaction of the mixture, when determining the salivary enzyme, did not yield the optimum effects.

Snyder, Marshall L., 1938. COMPARISON OF TEST TUBE AND QUANTITATIVE PLATE METHODS FOR ESTIMATION OF *LACTOBACILLI* IN SALIVA. Jour. Dental Res., 17 (4): 333-334.

"After determining quantitative plating technique employed by Hadley, Hay, Bunting et al. to be satisfactory for estimation of lactobacilli in saliva, attempt was made to devise test tube method to supplement plate and microscopic work. Hoped to show that within limits, production of acid was function of time and number of lactobacilli in saliva. Medium used-glucose infusion agar adjusted to pH 5.0 with bromocresol as indicator; inoculation made with 0.1 - 0.3 cc. quantities of saliva, and color changes which ranged from blue-green of controls and negative tests, to yellow of completely changed medium, were recorded every 12-24 hours for 96 hours. A total of 725 salivas were tested, and color changes compared with respective plate counts made independently by Jay. Of these, 289 specimens were negative or contained less than 100 lactobacilli per cc. of saliva. Significant color changes were observed in only 5, or 2.0%, of these cases in 48 hours. So far, however, it has not been possible, with salivas containing more than 1,000 lactobacilli per cc. of saliva, to differentiate accurately between high and low counts with this method." (Author's abstract)

Snyder, Marshall L., 1939. THE OCCURRENCE OF *LACTOBACILLI* AND OTHER ACIDOGENIC ORGANISMS IN THE SALIVAS OF SELECTED CARIES-FREE CHILDREN. Jour. dental Res., 18 (6): 497-511.

Lactobacillus counts were made of the salivas of two groups of caries-free children. Lactobacilli were cultured irregularly over an 18-month period; a modification of Hadley's count method (cr. Hadley, 1933) was employed.

Eleven of 159 specimens obtained from 17 children from Maumee, Ohio, were positive for lactobacilli, as were 85 of 178 specimens obtained from 21 children from Ann Arbor, Michigan. At the end of the study, the teeth of one Maumee child showed a small extension, while six Ann Arbor children were definitely susceptible to caries.

On the basis of lactobacillus counts, children having no salivary lactobacilli at the outset of this study remained free of caries, while those having significant numbers showed signs of dental decay.

Counts of yeast, streptococci and staphylococci were also made (cf. Tables II, III, and IV), but no definite significance could be attached to the presence of these organisms in saliva in relation to dental caries. The yeasts presented a possible, but apparently secondary factor in caries.

Snyder, Marshall L., 1939a. A SIMPLE METHOD FOR THE ESTIMATION OF THE NUMBERS OF *LACTOBACILLI* IN THE SALIVA IN RESPECT TO DENTAL CARIES. Jour. dental Res., 18 (3): 242-243.

"It was attempted to supplement the quantitative laboratory procedures for the estimation of the numbers of lactobacilli in the saliva as an

index of caries with a simple colorimetric method which would give essentially the same information more rapidly and easily and also be available for the average practicing dentist. Preliminary experiments established that beef infusion agar adjusted to pH 5.0 with either glucose or lactose as the carbohydrate and brom-cresol-green as the indicator was a satisfactory selective medium. With a series of 805 samples, test tubes of this medium were inoculated with 0.1-0.2 c.c. saliva and the color changes occurring in selected time intervals were compared with independent lactobacillus counts of the respective specimens. It was found possible to select in 48 hours with less than 2 per cent error those specimens containing no lactobacilli and with less than 4 per cent error those specimens estimated to have under 1,000 lactobacilli/c.c. of saliva. Where counts higher than this level were encountered, it was not possible to interpret accurately color changes in respect to numbers of lactobacilli." (Complete paper.)

Snyder, Marshall L., 1940. A SIMPLE COLORIMETRIC METHOD FOR THE ESTIMATION OF RELATIVE NUMBERS OF LACTOBACILLI IN THE SALIVA. Jour. dental Res., 19 (4): 349-355.

Measured amounts of saliva obtained from 38 caries-free children and 134 medical students were added at 45° C. to "shake" tubes containing beef infusion agar and glucose or lactose and brom-cresol-green (pH 3.8-5.4) as indicator. The tubes were immediately cooled and were observed daily for 4 days at 37° C. Color changes were graded from 0 (no change) to 4 (a complete shift from blue-green to yellow). A definite correlation between intensity and time of color change and the number of organisms was established.

A comparison was made of acid tomato-peptone agar plate counts of lactobacilli in saliva with color changes in the "shake" tubes inoculated with 0.1 cc. of each of 363 saliva specimens. At 24 hrs., only 1 specimen (100,000 lactobacilli/cc. saliva) produced a significant color change; at 48 hrs., 139 specimens were positive, 2 having lactobacillus counts less than 1,000/cc. saliva. Results followed the same trend at 72 and 96 hours.

Similar tests were carried out using 0.2 cc. of saliva (280 specimens) as inoculum and showed that at 24 hours, 1 specimen (50,000 to 100,000 lactobacilli/cc. saliva) produced a significant color change; at 48 hrs., 93 samples were positive, showing that an increase of inoculum from 0.1 to 0.2 cc. caused a corresponding increase in positive reactions within 48 hrs.

In both studies it was apparent that acid production could not be attributed solely to the presence of lactobacilli.

Another test was made, using 162 saliva samples (0.2 cc. each) as inoculum and lactose substituted for glucose, to determine whether another carbohydrate might produce better differentiation. At 24 hrs., no specimens were positive; at 48 hrs., 53 were positive (of these, 5 were specimens with less than 5,000 lactobacilli/cc. saliva); at 72 hrs., all specimens (65) with counts over 5,000 were strongly positive.

A discussion of the possibility of direct application of this method in the study of dental caries is presented.

Snyder, Marshall L., 1941. A SIMPLE COLORIMETRIC METHOD FOR THE DIAGNOSIS OF CARIES ACTIVITY. Jour. Amer. dental Assoc., 28 (1): 44-49.

A colorimetric method is described for the testing of dental caries activity, based on acid production by oral lactobacilli in a selective carbohydrate medium. When tested on 63 children, both carious and caries-free, the test proved very accurate as compared with clinical examinations.

Snyder, Marshall L., 1942. CORRELATION AND COMPARISON OF LABORATORY FINDINGS WITH THE CLINICAL EVIDENCE OF CARIES ACTIVITY IN A GROUP OF SIXTY-SIX CHILDREN. Jour. Amer. dental Assoc., 29 (17): 2001-2011.

The full paper concerns the study of the correlation of lactobacillus counts and acid production in saliva with caries activity. A group of 66 children in the kindergarten, first, second, and third grades were studied over a period of two years. Paraffin-stimulated saliva was collected at approximately monthly intervals during the school year, averaging 12 samples per child. The samples were cultured within two hours after collection by the colorimetric and plating methods. Data on the description of the two methods and their comparative value in determining the presence of lactobacillus in the saliva are as follows:

For the colorimetric technic 0.1-0.2 ml. of saliva was placed in tubes of melted glucose agar (pH 4.7-5.0) containing bromocresol green as an indicator. The inoculum was mixed by rotation, and the agar allowed to solidify. The tubes were then incubated at 37° C. The author states that the color test is a reflection of acid production by all the bacteria inoculated with the saliva, but for all practical purposes the color reactions are taken to be caused by lactobacillus. As the acid is produced the color changes from the initial bluish green to a distinct yellow. Only those reactions in which green was not the dominant color (below pH 4.2) were recorded as positive for lactobacillus.

To obtain lactobacillus counts 0.1-0.2 ml. of saliva were placed on a tomato-peptone-agar plate and an additional 0.6-0.8 ml. of saliva was placed in an acid-glucose broth (pH 5.0). All the cultures were incubated at 37° C. The glucose broth was examined microscopically in 48 hours; the plates were observed at the end of 96 hours, at which time the number of characteristic morphologic colonies of lactobacilli was determined.

Constant absence or occasional presence of lactobacillus and of positive color reactions were considered to be indicative of negative caries; whereas constant presence of lactobacilli and positive or intermittent negative reactions were considered to signify caries activity.

The author concludes that the colorimetric method is advantageous because it is simple, rapid, and accurate; requires a small amount of laboratory equipment and no special skill; and positive results can be obtained in one-fourth to one-half the time necessary for lactobacillus counts.

Snyder, Marshall L., and June J. Teachout, 1942a. ACID PRODUCTION OF ORAL BACTERIA ASSOCIATED WITH DENTAL CARIES. Jour. dental Res., 21 (5): 461-466.

Thirty strains each of staphylococci and streptococci (from the salivas of children showing presence and absence of dental caries activity), lactobacilli and yeast-like organisms (from the salivas of children showing clinically active caries) were tested for acidogenic and aciduric properties.

To test the effect of acidity on growth of staphylococci, streptococci, and lactobacilli, 18-hour glucose broth cultures of each strain were plated on tomato agar adjusted to pH 4.5, 4.7, 5.0, 5.3, and 5.5: the plates were incubated at 37°C. for 96 hours. Results showed that all microorganisms thrived at a pH of 5.5; all strains of lactobacilli and staphylococci grew at 5.0; only 25 strains of staphylococci persisted at 4.7; and only 25 strains of lactobacilli and 10 strains of staphylococci grew at 4.5.

In the second experiment, the acid production and viability of the microorganisms was studied. All strains were inoculated into glucose broth. Viability was tested daily by subculture for 10 days; acidity was determined on the tenth day by use of a spot plate with brom-phenol-blue and brom-cresol-green as indicators. Only 2 strains of streptococci survived for 10 days; staphylococci, lactobacilli, and yeast-like organisms grew readily. The average final pH was 4.6 for streptococci, 4.7 for staphylococci, 5.0 for yeasts, and 3.8 for lactobacilli. Indicator tests (brom-cresol-green dextrose agar, pH 4.75) on pure and mixed cultures showed a color change in mixed cultures of lactobacilli and yeasts, lactobacilli and staphylococci, lactobacilli and streptococci in 24 hours; for staphylococci alone in 48 hours; for staphylococci and yeast, for staphylococci and streptococci in 72 hours; and for yeast alone in 96 hours. No change was effected by either streptococci or yeasts alone in 4 days. No indication of increased acid production was observed when symbiotic mixtures were used.

Snyder, Marshall L., and Marjorie K. Clark, 1948. RELATIONSHIP OF ORAL STRAINS OF CANDIDA ALBICANS TO THE PROTECTIVE ACTION OF AMMONIA IN DENTAL CARIES. *Bacteriol. Proc.*, 1 (1): 68.

"Substitution of phenol red glucose broth (pH 7.4) for acid glucose broth (pH 5.0) as a diluent in the technique for estimating numbers of lactobacilli in the saliva led to the following observation: After an initial acid production, reversion in 4-30 days to the alkaline side of the indicator was not uncommon. This reaction occurred in 51 of 325 specimens of saliva diluted in phenol red glucose broth (pH 7.4). In each case yeast forms were cultured in combination with lactobacilli, staphylococci or both. Only the yeast forms, subsequently identified as *Candida albicans*, produced a terminal alkalinity in this medium. Since Kesel and associates have shown in their studies of dental caries that ammonia, furnished in the form of urea and dibasic ammonium phosphate, exerts a protective role, it was thought of interest to test the activity of oral strains of *C. albicans* on urea. Thirty strains, including six known to produce basic reactions, were grown in Christensen's urea medium under aerobic and semi-anaerobic conditions and with varying concentrations of glucose (0.0, 0.1 and 0.5 percent).

All strains grew readily on this medium but none attacked urea. If, therefore, urea is hydrolyzed by microbic action to release ammonia in the oral cavity, these results suggest that *C. albicans* is not actively associated with this process."

Snyder, Marshall L., and Margery K. Clarke, 1949. TERMINAL ALKALINITY IN SALIVA-PHENOL RED GLUCOSE BROTH CULTURES. *Jour. dental Res.*, 28 (5): 503-506.

Two hundred and six saliva specimens, mixed with phenol red glucose broth, were held at 37°C. for 30 days; the production of terminal alkalinity was observed. 52 specimens (25%) contained *Candida* and 31 of these (15% of total) showed terminal alkalinity. Of the 31 strains of *Candida* producing alkalinity, 28 were identified as *C. albicans* and 3 as *C. krusei*.

Snyder, Marshall L., 1949a. THE PROTEOLYTIC ACTIVITIES OF ORAL STRAINS OF THE GENUS CANDIDA (MONILIA). *Jour. dental Res.*, 28 (6): 640.

"The frequent reversion to alkalinity after initial acidity in saliva-glucose broth (pH 7.4) cultures is nearly always caused by members of the genus *Candida* (Monilia). This change results from the liberation of basic products from the organic nitrogenous substances in the medium and can be classified under the broad term of proteolysis. Because of recent interest in the proteolytic activity of oral bacteria, the ability of these oral yeastlike forms in attacking various types of protein or protein derivatives and urea was investigated. Strains of *Candida* were isolated from one hundred individuals whose saliva contained these forms. These were classified culturally: *C. albicans* (82), *C. Krusei* (8), *C. pseudotropicalis* (1), *C. tropicalis* (3), unidentified (6). These in turn were grown in media containing, as the sole source of organic nitrogen, urea, peptone, and meat extract. In addition, gelatin and coagulated blood serum (Loeffler's medium) were also tested. Only with peptone and meat extract were changes observed indicating release of basic substances. Neither gelatin nor the coagulated blood serum was attacked in 30 days. The results indicated that members of the genus *Candida* do not attack protein or protein derivatives much higher in structure than peptones, and the latter slowly." (Complete paper.)

Snyder, Marshall L., and Margery K. Clarke, 1950. EVALUATION OF THE COLORIMETRIC (SNYDER) TEST. I. Comparison of positive color reactions with the Lactobacillus counts of respective specimens of saliva routinely submitted for culture. *Jour. dental Res.*, 29 (3): 298-303.

"Comparison of data obtained by the Snyder test with lactobacillus counts of respective specimens of saliva showed the following relationships:

"1. With less than 10,000 lactobacilli/c.c. saliva, 98 per cent of specimens failed to produce a positive color reaction in 24 hours and 71.5 per cent in 48 hours.

"2. With more than 10,000 lactobacilli/c.c. saliva, 33.4 per cent of specimens induced positive color tests in 24 hours and 90 per cent in 48 hours.

"A practical interpretation of these results for possible office use of the Snyder test is offered." (Authors' summary.)

Snyder, Marshall L., and Dorothy F. Donnelly, 1951. MUCINOUS POLYSACCHARIDE PRODUCTION FROM SUCROSE BY ORAL BACTERIA. *Jour. dental Res.*, 30 (4): 522-523.

"The production of mucinous colonies on sucrose-containing media by oral bacteria offers a convenient method for the isolation of organisms causing this reaction. As part of the study on a possible relationship between this synthesis and mucinous plaque formation, an analysis of the media employed was conducted to establish the influence of each component. Mucinous colonies were obtained in a medium composed by the following minima: 3 per cent sucrose, 1 per cent tryptose (Bacto), 0.5 per cent agar, and pH 6.0. Optimal results in respect to colony size were obtained with a medium composed as follows: 5 per cent sucrose, 2 per cent tryptose, 1.5 per cent agar, and pH 7.4. Phosphate in monobasicpotassium form inhibited the development of mucinous colonies. Blood did not improve the medium. In more than 300 specimens of saliva from representative age groups mucinous colonies were constantly cultured in numbers ranging from 4.5×10^6 to 5.0×10^9 per ml. saliva. Two basic colony types were transitional stages were encountered: the first was a soft smooth colony easily emulsified while the other was rough, granular, of cut glass appearance and extremely difficult to emulsify. The rough type was more frequently observed in the older groups. These colonies were made up of gram-positive cocci in chains. Their identity was accepted as *Streptococcus salivarius*. No other organism in these specimens of saliva was observed to form colonies similar to those of the streptococci on sucrose agar under aerobic conditions irrespective of whether the medium contained blood or penicillin. There was no correlation between the incidence of these organisms or colony types and numbers of lactobacilli in respective specimens of saliva." (Complete paper.)

Snyder, Marshall L., and Dorothy D. Johnston, 1952. SYNTHESIS OF MUCINOUS POLYSACCHARIDES BY ORAL BACTERIA. *Jour. dental Res.*, 31 (4): 471.

"Our previous studies have reported the incidence of mucinous polysaccharides synthesis, as evidenced by the formation of large and variable mucinous colonies on 5 per cent sucrose tryptose agar, to be limited to a single bacteriological type, *Strep. salivarius*, and the nature of the polysaccharide formed to be a levan. By the use of penicillin in the medium it is possible to inhibit the growth of this type and detect colonies of bacteria capable of synthesizing dextrans. The size and nature of these colonies never approaches that of the levan forming streptococci. Several hundred specimens of saliva have been cultured on 5 per cent sucrose tryptose agar with and without penicillin (0.1 unit/ml.) under aerobic and anaerobic conditions. After 48 hours incubation half of each plate was sprayed with Gram's iodine for the production of the characteristic reddish-purple reaction with dextrans. Purple-staining colonies were found in 20 to 50 per cent of each group of specimens cultured. There was no appreciable difference in occurrence of these colonies on plates incubated aerobically or anaerobically. All strains producing dextrans were observed to be Gram-negative diplococci.

Streptococci of the dextran-forming type (*Strep. s.b.e.* or *Strep. sanguis*) were not encountered. This seemed rather strange in view of their high incidence in bacteremias following extraction of teeth. It is possible that the high dilution of saliva (1-1,000,000) used to obtain adequate isolation partially accounts for this discrepancy. The biochemical and serological properties of these gram-negative diplococci will be reported later." (Complete paper.)

Sognnaes, R. F., and J. F. Volker, 1941. STUDIES ON THE DISTRIBUTION OF RADIOACTIVE PHOSPHORUS IN THE TOOTH ENAMEL OF EXPERIMENTAL ANIMALS. *Amer. Jour. Physiol.*, 133 (1): 112-120.

A study was made of the distribution of radioactive phosphorus (P^{32}) in the enamel of 8 cats, 5 dogs, and one monkey. In 2 of the dogs studied the effect of the contact of the enamel surface with salivary secretions containing the isotope was especially noted. The teeth of one dog were completely covered by specially fitted metal trays. In a second dog the teeth on the left side of the mandible and maxilla were covered by a similar device and the teeth on the right side remained in continuous contact with saliva, the secretion of which was augmented by electric stimulation of the chorda tympani nerve on the same side. Periodic determinations of the radio-phosphorus content of the saliva were made and samples of surface enamel, remaining enamel, and crown and root dentin from the covered and uncovered teeth were compared for P^{32} content.

Results showed the radiophosphorus activity in the first dog to be lowest in the surface enamel and increasing as the dento-enamel junction was reached. In the second dog, the P^{32} content of the surface enamel of the covered teeth was negligible, while the surface enamel of the uncovered teeth was 60 times greater in activity. It is suggested that these results indicate that the high concentration of P^{32} in the surface enamel of the uncovered teeth is of salivary origin. In vitro tests with dog teeth and saliva and human teeth and saliva, to which radioactive phosphorus had been added, further substantiated this suggestion.

Sognnaes, Reidar, and J. H. Shaw, 1952. SALIVARY AND PULPAL CONTRIBUTIONS TO THE RADIO-PHOSPHOROUS UPTAKE IN ENAMEL AND DENTIN. *Jour. Amer. dent. Assoc.*, 44 (5): 489-505.

A comparative study was made of the P^{32} distribution in normal and desalivated monkeys and dogs, animals with intact and with root-filled teeth, and in living and dead extracted teeth. Experiments were run from 5 to 216 hours and an average of 10 millicuries of P^{32} was given intravenously. The external surface of the animal's teeth were so protected as to be exposed only to non-radioactive normal, radioactive biological, radioactive artificial, or modified saliva; bacterial activity of the preparations was prevented by the addition of a minute amount of thymol. Gravimetric separation by flotation-centrifugation, surface grinding, radioautography, and segmentation methods were utilized in securing sample preparations of tooth substance: a Geiger-Muller tube and Tracelab Autocaler provided means of determining radioactivity.

Gravimetric separation methods revealed no significant differences in the P^{32} radioactive

counts in the tooth enamel and dentin between desalivated and intact monkeys; the radioactivity of the external enamel was greater than that of the internal in both the control and experimental groups; and in the absence of saliva, contact of the dental surface with sublingual secretions and the mucosa of the oral cavity, produced results which more closely approximated the normal than when the teeth were kept dry by capping. In intact animals the radioactivity of mixed salivary secretions was no more than that of mixed secretions of the remaining intact mucous gland secretions of desalivated animals.

In desalivated animals certain areas of the enamel were found to be significantly reduced in P^{32} activity. A similar degree of radioactivity as well as a P^{32} gradient towards the external surface was noted in bilaterally symmetrical teeth which had been allowed to remain in contact with radioactive saliva. Those teeth not in contact with radioactive saliva showed negative external enamel P^{32} counts nor was there any penetration of the surrounding salivary fluids by the P^{32} during a period of three hours. Although alteration of the osmotic pressure by the addition of sucrose to the saliva did not modify the passage of P^{32} from the pulp to saliva, traces of the radioactive material passed from the dentin to the enamel over a 24-hour period; furthermore the addition of sucrose appeared to inhibit the passage of P^{32} toward the center in dentin and in enamel.

If vital and extracted teeth were allowed to remain in contact with radioactive saliva for the same length of time, the former was shown to have a radioactive count from three to nine times that of the latter, thus indicating that the saliva was the primary source of radioactivity for the enamel of the teeth; this was also found to be true in the intact animal. Blood was the main source of P^{32} of the dentin.

Sohier, R. and A. Nabonne, 1939. PROCÉDÉ SIMPLE ET RAPIDE DE PRÉLEVEMENT DE LA SALIVA PAROTIDIENNE. APPLICATIONS PRATIQUES [A simple, rapid method of collecting parotid saliva. Practical applications]. *Compt. rend Soc. Biol. (Paris)*, 131: 881-883.

Description is given of a device, for rapid and sterile collection of parotid saliva, which is attached to the parotid duct by means of a flanged cupule capping the orifice of Stensen's duct. The device has been used to study the saliva of patients with mumps.

Sohier, R., and Ch. Jaulmes, 1939a. ALTÉRATIONS ET INCLUSIONS PROTOPLASMIQUES DES CELLULES ÉPITHÉLIALES ÉLIMINÉES PAR LA SALIVE PAROTIDIENNE DES MALADES ATTEINTS D'OREILLONS [Alterations and protoplasmic inclusions in epithelial cells eliminated in parotid saliva of patients with mumps]. *Compt. rend. Soc. Biol. (Paris)*, 131: 1000-1003.

Examination of the parotid saliva, of patients with mumps, collected without catheterization of the parotid duct. (Sohier 1939), showed the abundant presence of glandular epithelium, principally of acinus which may be eliminated as a unit, and a few leukocytes. A description eliminated epithelial cells.

Solem, G. O., and P. A. Lommen, 1915. THE INFLUENCE OF THE EXTRACT OF THE POSTERIOR LOBE

OF THE HYPOPHYSIS UPON THE SECRETION OF SALIVA. *Amer. Jour. Physiol.*, 38 (3): 339-349.

"1. Pituitrin invariably caused a diminution in flow of blood and saliva from the submaxillary gland, as shown from results obtained from 30 dogs and 1 cat.

"2. The decrease in flow of saliva was greater than the accompanying decrease in blood flow.

"3. The slowing of blood was less marked if the injection was made during faradization of the chorda tympani than during pilocarpine-stimulation, while the slowing of saliva was the same.

"4. Pilocarpine was relatively ineffective even when injected seven or eight minutes after pituitrin.

"5. While epinephrin normally caused a vasodilation of the gland and increase in salivary secretion, epinephrin during the action of pituitrin had the normal effect on the blood flow but caused a diminution in salivary flow, probably due to the greater quantity of pituitrin coming in contact with the gland.

"6. When pituitrin was injected during the action of chrysotoxin, the decrease in the flow of saliva set in before the vasoconstriction in the gland occurred. In five out of seven cases, the flow of saliva slowed while there was active vasodilation in the gland.

"From these results we must conclude that the decrease in flow of saliva following the injection of pituitrin is due to inhibition of the action of the secretory nerves to the submaxillary gland, but also due in part to the accompanying vasoconstriction, which is caused by direct action on the muscles of the arterioles or the effect on the peripheral endings of the vasomotor nerves, but more probably to the effect on both. The decrease in output of blood from the gland may be also due to the decreased activity of the gland." (Authors' summary and conclusion.)

Solomon, Harold A., Melvin C. Reinhard, and Hilda Lee Goltz, 1938. SALIVARY INFLUENCE ON GALVANISM. *Dental Items* 60 (11): 1047-1052.

In vitro studies of the potential difference between metallic dental restoration substances in saliva (used as the electrolyte) reveal that voltage differences exist between amalgam and Vitallium, Oralium, and gold, with potential variances existing between individuals and the same individuals at different daily time periods. In vivo and comparative in vitro studies indicate that no current exists in the soft tissues of the mouth or that no potential difference can be detected between metallic dental substances in the oral cavity. Colloid film formation on the metallic restorations was found to be a contributory factor in the prevention of current flow in vivo and in vitro.

Sollmann, Torald, and R. L. Howard, 1925. THE CATALASE ACTIVITY OF THE ORAL MUCOUS MEMBRANE. *Jour. Lab. clin. Med.*, 11 (2): 130-139.

A method for determining the catalase index of the mouth is described. The index is obtained by determining the rate of decomposition of hydrogen peroxide in the mouth under standardized conditions. A study was made of 25 cases in which the catalase index was compared with the condition of the mouth. Most clinically normal mouths gave indices below 4 cc. for the first

determination and 3 cc. for the second; the indices of moderately diseased mouths (caries, inflammation of gums) did not exceed those of normal mouths; most of the markedly diseased mouths (pyorrhea, pathologic lesions) gave indices above 4 cc. for the first and 3 cc. for the second determination. Five normal cases were studied over a period of weeks and the catalase index was found to vary somewhat from day to day. The effect of increased salivation, suppressed salivation, smoking, and sore throat on the index was investigated but no definite effect of any condition was noted.

Soyenkoff, Basil C., and Claus F. Hinck, Jr., 1935. THE MEASUREMENT OF pH AND ACID-NEUTRALIZING POWER OF SALIVA. *Jour. biol. Chem.*, 109 (2): 467-475.

Electrometric methods were applied for the determination of pH and acid-neutralizing power of saliva. The subjects were 20 to 45 years old with normal oral conditions except for a few with active caries. Saliva was allowed to accumulate in the mouth for a certain period. A capillary quinhydrone electrode or MacInnes glass electrodes were used and found to differ by less than 0.02 pH unit. The glass electrode gave more reproducible results and proved easier to handle.

Saliva was obtained between 3 and 4 p.m. Resting and paraffin-activated salivas were collected. Samples were transferred directly from the mouth to the glass electrode vessel by means of a funnel. The pH of 9 samples of resting saliva from 9 subjects ranged from 6.37 to 6.89. The pH of the stimulated saliva varied between 6.97 and 7.32. In additional samples obtained from 4 subjects between 11 a.m. and 12 noon and between 5 and 6 p.m., the pH values of resting saliva were 6.40 to 6.88; of stimulated saliva, 7.00 to 7.27. The average pH of all these data for resting saliva is 6.64; for stimulated, 7.13.

Five men served as subjects in a series of experiments on the buffering power of saliva. Samples were obtained at various hrs. between 9:00 a.m. and 9:00 p.m. pH changes upon titration with 0.1 N HCl and 0.1 N NaOH are presented in Table 1. The saliva samples differed markedly in their acid-neutralizing power.

Conductometric titration of saliva samples with 0.1 N HCl showed that the conductivity increase became rapid and uniform beyond the point where sufficient acid had been added to obtain pH 4. It was thus concluded that the buffer range of saliva constituents lies on the alkaline side of pH 4.

Spain, W. C., Reginald E. Gillson, and Margaret B. Strauss, 1942. COMPARATIVE IMMUNOLOGIC STUDIES WITH SALIVARY AND EPITHELIAL EXTRACTS OF THE DOG, CAT, AND RABBIT. *Jour. Allergy*, 13 (6): 563-573.

The presence of a common antigenic factor in the saliva or in the epithelium of dogs, cats, and rabbits was determined by testing extracts of hair and skin scrapings, and of saliva on humans and guinea pigs. Skin tests were performed on individuals sensitive to dogs, cats, and/or rabbits. It was demonstrated that those persons sensitive to one extract of the same species were sensitive (closely similar reactions resulted) to the other.

Neutralization tests, using varying concentrations of salivary or epithelial antigen-extracts from a dog or cat to neutralize the serum-antibodies from sensitive individuals, revealed that approximately the same unit strength (usually 200 units) of salivary or epithelium extract was needed to reach a neutralization point. An anatomical site previously injected intracutaneously with an antigen (extract-neutralized serum) antibody preparation and showing no reaction to one antigenic extract, failed to display any reaction to the corresponding extract of the same species; thus, indicating that there was no demonstrable extra antigenic-fraction present which could elicit a reaction from a previously (salivary or epithelial extract) desensitized area. However, in vitro tests, made upon guinea pigs' uterine horns in a Dale-type oxygenated bath of Tyrode's solution, suggested the presence of an additional antigenic-factor(s?) in saliva.

It is concluded that a common antigenic factor exists in the salivary and epithelial extracts from dogs, cats, and rabbits. The possibility of an additional salivary antigenic-factor is discussed.

Spealman, C. R., 1943. THE VOLUME FLOW OF RESTING SALIVARY SECRETION. *Amer. Jour. Physiol.*, 139 (2): 225-229.

Saliva samples were collected on a series of male dental students, 20-29 years old, in order to formulate a standard technique and to establish normal limits of the volume flow of resting saliva.

Determinations were carried out in the mid-morning or mid-afternoon. Subjects were asked not to smoke, chew gum, or eat candy, and to avoid emotional stress. The subject was placed in a sitting position with his head bent forward to the horizontal. The saliva was allowed to flow into a beaker held in close contact with the lips. Mouth breathing, movements of the tongue, etc., were avoided. Saliva was collected for 5 min.; after this time a second beaker was quickly substituted. The volume of the second collection, which represented a steady flow, was measured into 10 cc. portions after adding 0.1 cc. butyl alcohol to destroy the foam.

The experimental data indicated that the mean of a sufficient number of determinations represents a value which is reproducible and characteristic of the individual. The distribution curve of the means of 2 determinations for each of 58 subjects is skewed, the mean and the mode of the distribution curve being respectively 0.37 and 0.24 cc./min. The lowest mean obtained was 0.08 cc./min.; the highest, 0.88 cc./min.

Spencer-Payne, A. Ll., 1924. SALIVA - ITS PROTECTIVE ACTION UPON THE TEETH. *Brit. dent. Jour.*, 45 (24): 1637-1643.

The various theories of what constitutes the essential protective elements in saliva are discussed. These theories include rate of flow, alkalinity, sulfocyanates, quantity of mucin, calcium content.

Spengler, Felix, 1935. DIE KEIMTOTENDE WIRKUNG DES SPEICHEL RHODANIDS IN SALZSAURE [The germicidal action of salivary thiocyanate in HCl]. *Zeitschr. f. Immunitätsforsch.*, 85 (3/4): 307-313.

Thirty *in vitro* tests were made concerning the antibacterial action of salivary thiocyanate in HCl on *Bact. coli* [*Escherichia c.*] and staphylococci. The potassium thiocyanate was found to increase the germicidal properties of the HCl (which was of the concentration and dissociation of that in gastric juice).

Squires, B. T., 1953. HUMAN SALIVARY AMYLASE SECRETION IN RELATION TO DIET. *Jour. Physiol.* (London), 119 (2-3): 153-156.

Estimations of salivary amylase were made by the "achromic end-point" technique in four groups of subjects, each with different diet habits. Group I consisted of 90 adult Tswanas of the Bechuanaland Protectorate who live on a predominantly carbohydrate diet; Group II was composed of 10 carnivorous Bushmen of the Kalahari desert who subsist chiefly on a diet of snakes, lizards, birds and game; Group III consisted of 32 adult Europeans on a good, mixed diet; Group IV consisted of five normally-carnivorous Bushmen who had lived on a different diet (mainly carbohydrates) for three months. Highest salivary amylase activity (248 units/ml. of saliva) was observed in group I, and was associated with the predominantly carbohydrate diet. Group II had an average of 22 units/ml. of saliva, the lowest activity observed; the average finding for the European group was 101 units/ml. of saliva, and for group IV, 95 units. The high salivary amylase activity was associated with a high serum diastatic index of 64-132, as compared with the usually accepted values of 32-64 for Europeans.

Sreebny, Leo M., E. R. Kirch, and R. G. Kesel, 1950. THE LOCATION OF THE GLYCOLYTIC ENZYMES IN SALIVA. *Jour. dental Res.*, 29 (4): 506-511.

Experiments, based on a series of filtrations through Seitz and Pyrex "UF" filters, indicated that the location of glycolytic enzymes in saliva is intracellular--that is, that they are principally found in the microorganisms of the oral cavity.

Sreebny, Leo M., and M. B. Engel, 1951. COLLAGENASE-LIKE ACTIVITY IN A SALIVARY FRACTION. *Jour. dental Res.*, 30 (4): 493-494.

"Paraffin stimulated, pooled, whole saliva was incubated at 37° C. for 72 hours, and subsequently lyophilized (Fraction No. 1). A portion of the powdered residue was dissolved in distilled water and filtered, in the cold, through a Pyrex "UF" fritted glass funnel. The filtrate was dialyzed against distilled water for 48 hours. Both the dialysate (Fraction No. 2) and the nondiffusible portion (Fraction No. 3) were collected, centrifuged, and lyophilized. The salivary fractions thus obtained were tested for depolymerizing activity with azocoll, a diazotized dye hide powder preparation which liberates a red color when treated with collagenase. This reaction is believed to occur as a result of the depolymerizing effect of this enzyme on the glycoprotein components of the ground substance contained in the hide powder. The azocoll was added to a series of tubes, one of which contained whole saliva, while the others held the different salivary fractions, dissolved in M/15 phosphate buffer, pH 7.0 with Merthiolate (1:10,000). The tubes were agitated

for 24 hours at 37° C. Liberation of the red dye was noted after about three hours of incubation in the tubes containing the whole saliva and the lyophilized-dialyzed fraction, indicating the actions of a collagenase-like enzyme. The color became more intense during 24 hours. The absence of color formation in the tube containing the undialyzed-lyophilized saliva, suggested the presence of an enzyme inhibitor(s) in the dialysate. The presence of such a mechanism was confirmed by incubating the azocoll-lyophilized-dialyzed mixture with a series of concentrations (.001-3 per cent of the dialysate). The resultant color changes revealed a graded inhibitory effect ranging from almost "complete inhibition" (3 per cent) to "no inhibition" in the more dilute solutions (0.1-0.5 per cent)." (Complete paper).

Stack, Maurice V., 1953. THE INDEPENDENCE OF CARIES EXPERIENCE AND SALIVARY TRYPTOPHANE. *Jour. Dental Res.*, 32 (5): 736.

Saliva was obtained under standard conditions and clarified before analysis. Difficulty was experienced in obtaining quantitative data used by Turner and Crowell (1947) for their qualitative study in which the presence of tryptophane was correlated with resistance to caries. Satisfactory results were obtained using a method, similar to that of Berg, et al (1946), in which salivary samples were reacted with p-dimethylamins-benzaldehyde in acid solution and adding a trace of nitrate. The mean salivary tryptophane content, calculated from the pooled values of Berg et al (1946), who incubated saliva under aerobic conditions for 1 hour before analysis, was 22.4±9 (S.D. µg./ml. (34 cases grouped according to periodontal condition). Present results show a mean salivary tryptophane content of 23±8µg./ml. for the 3 subsidiary groups selected for this study, and 22±9µg./ml. for the main group of 55 cases. When ranked in 5µg. steps, from 6 to 40µg., the central values for each group were about half as numerous as would be expected for a normal distribution. Combining all groups (145 values, the numbers falling within these seven successive intervals were 5, 19, 39, 23, 38, 13 and 8 respectively; this anomalous distribution was not observed in a study of variation in salivary protein concentration by Gorlin (1948). His results together with those of previous workers, lead to the value of 2.9±0.6 (S.D.) micrograms per milliliter (186 cases). The correlation coefficient for DMF counts and salivary tryptophane levels was 0.10. It is considered likely that tryptophane was not observed previously in the saliva from caries-active patients because of the more rapid drop in redox potential of such saliva, as had been noted by the same authors. (From author's abstract)

Stack, Maurice V., 1954. THE INDEPENDENCE OF CARIES EXPERIENCE AND SALIVARY TRYPTOPHANE CONTENT. *Jour. Dental Res.*, 33 (3): 316-320.

Estimation of the total tryptophane content in paraffin-stimulated samples of saliva from 145 persons was made by measurement of optical density of samples reacted with p--dimethylaminobenzaldehyde. A mean tryptophane level of 23±8 (standard deviation) µg./ml. of saliva was observed, with a low number of values found to occur in the central range. No definite correlation was found between DMF counts and the salivary tryptophane level.

Staritskaia, L. N., 1953. IZMENENIE SODERZHANIYA FENOLOKSIDAZY V SLIUNE SOBAKI PRI

DEIATEL'NOSTI SLIUNNYKH ZHELEZ [Changes in the phenoloxydase content of dog saliva during secretory activity]. *Voprosy pitaniia*, 1: 38-42. Sovet. med. refer. Obozrenie, 1954 (18): 96.

Variation in the oxydase content during prolonged salivary secretion was studied in dogs having parotid and submaxillary fistulas. Rusk or 0.25% hydrochloric acid were used as salivary stimulants. Enzyme determinations were made using pyrocatechin as a substrate. Results showed a gradual increase in the enzyme content of saliva secreted during a short, 5-minute period of secretion. A considerable decrease was found in the enzyme content of rusk-stimulated saliva samples collected toward the end of a 1 to 2-hour period of secretion; this decrease was more marked in prolonged acid-stimulated salivary secretion. A return of the enzyme to a normal salivary level usually occurred in such experiments after 5 to 6 days.

Starobinskii, I. M., 1928. NABLIUDENIĖ NAD KARIESOM ZUBOV U BEREMENNYKH ZHENSCHYIN I KONTSENTRATSIEI V IKH SLIUNE VODORODNYKH IONOV [Observation on dental caries in pregnant women and the concentration of H-ions in their saliva]. *Belaruskaja med. Dumka*, 4-5: 53-59.

The dental caries experience and salivary pH of 216 pregnant and 150 non-pregnant women were studied. The incidence of dental caries was found to be related to the age of the subject and not to pregnancy. Determinations, by the Michaelis method, of salivary pH of samples collected from 100 pregnant women, in the early morning during the third, sixth, and ninth months, showed respective average pH's of 7.05, 7.1, and 7.9; a pH range from 6.8 to 7.4 was observed. The salivary pH of pregnant women is considered to have no influence on their dental caries experience.

Starr, Henry E., 1922. STUDIES OF HUMAN MIXED SALIVA. I. The determination of the hydrogen ion concentration of human mixed saliva. *Jour. biol. Chem.*, 54 (1): 43-54.

The literature on the hydrogen ion concentration of human mixed saliva (secretions of the submaxillary, sublingual, parotid, and buccal glands) is reviewed.

A colorimetric method for the determinations of the hydrogen ion concentration is described fully. The subject allows saliva to accumulate in the mouth for a 5-min. period and then ejects the saliva into a thistle tube which is inserted below an oil surface in a test tube. After the ejection of the first sample, the subject chews paraffin vigorously for a second 5-min. period. He then ejects the accumulated saliva, removes the paraffin, and rests for 10 min. After resting, the subject allows the saliva to accumulate for the third 5-min. period. Saliva was collected under oil and the pH was determined immediately after ejection. 1 cc. of the saliva was added to a test tube containing 9 cc. of freshly boiled distilled water (pH 6.6 to 6.7) and 1 cc. of 0.01% aqueous solution of dibromothymolsulfonephthalein also under oil. The saliva and diluent were stirred thoroughly. The pH was determined by color comparison with suitable standards against a milk-glass background.

The use of paraffin as an activator resulted in an increase in pH by 0.10 to 0.60. In each

instance, the pH decreased to approximately its initial value after removal of the paraffin and the 10-min. test.

Experiments were made to determine the effect on pH of saliva of exposure to air at ordinary room temperature. 5 cc. saliva from a single ejection were collected under oil. One-half of this amount was exposed to the air and the pH was determined at intervals. 12 samples were examined. Mixed saliva rapidly increased in pH when allowed to stand exposed to air. An increase in pH was also found in a few experiments which were made without employing the oil method. The use of the oil method in preventing changes in pH during determinations is emphasized.

In studying the effects of centrifugation on pH of mixed saliva, 20 cc. of mixed saliva were collected below a 2-cc. layer of oil in a 25 cc. cylinder which contained 2 cc. of brom-thymol blue solution. The mixture was thoroughly stirred. 11 cc. were transferred to a centrifuge tube containing 1 cc. of oil and the tube was stoppered; a second 11-cc. portion was placed in a centrifuge tube without the protective oil layer and was left uncorked. The tubes were centrifuged for 10 mins. at 2,500 rpm. 10 samples from 4 subjects were examined. The initial pH values ranged from 6.55 to 6.85. After centrifuging, all samples showed an increase in pH of the supernatant saliva. In the open tubes, the average increase in pH was 0.30; in the stoppered tubes, less than 0.15. After mixing the supernatant liquid with the semisolid material, the pH of the open tube samples was still 0.10 to 0.30 pH higher than the initial values. In the corked tubes, the mixture was 0.05 to 0.10 higher in pH value than were the initial values.

Starr, Henry E., 1922a. STUDIES OF HUMAN MIXED SALIVA. I. The determination of the hydrogen ion concentration of human mixed saliva. *Jour. biol. Chem.*, 54 (1): 43-54.

A method is described for the colorimetric determination of the hydrogen ion concentration of human mixed saliva. Sialogogues, such as paraffin, produced an increase in salivary pH which returned to normal within 10 minutes.

Starr, Henry E., 1922b. STUDIES OF HUMAN MIXED SALIVA. II. Variations in the hydrogen ion concentration of human mixed saliva. *Jour. biol. Chem.*, 54 (1): 55-64.

The H-ion concentration in human mixed saliva was found to vary directly with the alveolar CO₂ after a noon meal, and to vary inversely with the H-ion concentration of the urine after ingestion of 15 gm. of NaHCO₃. Over-ventilation causes a decreased acidity of the saliva. The H-ion concentration of mixed saliva parallels the CO₂ and H₂CO₃ content of the blood.

Starr, Henry E., 1922c. STUDIES ON HUMAN MIXED SALIVA. II. Variations in the hydrogen ion concentration of human mixed saliva. *Jour. biol. Chem.*, 54 (1): 55-64.

Simultaneous determinations of the salivary pH and the alveolar CO₂ content were made at intervals during the day on 5 normal subjects fed a mixed diet. Prior to the ejection of saliva, the mouth was kept closed for 5 min.; the saliva was collected under oil and its pH determined according to a method described earlier (cf. Starr, 1922m). A sample of alveolar air was taken

immediately after ejection, and the CO₂ content was determined by the Fridericia method. The findings indicate a close correlation between the salivary hydrogen ion concentration and the alveolar CO₂ content.

Samples of saliva and urine were collected under oil. Immediately following the collection, the subject ingested 10-20 g. NaHCO₃. pH determinations were made at intervals. 10 experiments were performed on 4 subjects. In every instance it was found that the urinary pH increased and the salivary pH decreased. Thus while the bodily fluids in general may be regarded as becoming more "alkaline" as the result of the administration of sodium bicarbonate, the mixed saliva became more "acid."

Voluntary deep breathing in open air for 10 min. resulted in an increase in salivary pH by 0.15 to 1.15. 9 subjects were used.

Studies on the effect of fatigue and excitement were made on a few subjects. Salivary pH determinations were made at 1/2-hr. intervals from 7:00 a.m. to 6:00 p.m. on subjects fed varied diets and exposed to different activity states. The findings showed a decreasing salivary pH with increasing fatigue. A sharp rise in pH was observed when subjects were emotionally excited (fear and anger) and a subsequent lowering of salivary pH as excitement subsided.

A comparison was made between the salivary pH of normal individuals and stammerers. 610 samples of saliva were obtained from 228 healthy normal subjects; 200 samples from 58 typical "subbreathing" stammerers; and 50 from 10 psychopathic stammerers. The pH range for normal individuals was found to be from 5.75 to 7.05. 86% of the specimens were between pH 6.35 and 6.80 inclusive. The mean, mode, and median practically coincided at about pH 6.60. A characteristically low pH was seen in the group of stammerers who were deficient in the use of their lungs and lethargic in behavior. The group of psychopathic stammerers showed an equally characteristic high salivary pH.

Starr, Henry E., 1922d. THE HYDROGEN ION CONCENTRATION OF THE MIXED SALIVA CONSIDERED AS AN INDEX OF FATIGUE AND OF EMOTIONAL EXCITATION, AND APPLIED TO A STUDY OF THE METABOLIC ETIOLOGY OF STAMMERING. *Amer. Jour. Psychol.*, 33 (3): 394-418.

Approximately 1300 examinations were made of the hydrogen ion concentration of mixed salivas and an attempt to correlate the findings with stammering was made. In general, stammerers may be divided into three groups according to metabolic state of energy or fatigue and breathing habits. The hydrogen ion concentration in conjunction with determination of the carbon dioxide content serves as a useful index of determining which group the individual falls into and what therapeutic measures are indicated.

Stavraky, George W., 1932. THE EFFECT OF BARIUM CHLORIDE ON THE SALIVARY SECRETION. *Jour. Pharmacol. exper. Therap.*, 45 (1): 53-64.

An investigation was made of the effects of barium chloride (0.005 to 0.01 gm./kg. of body wt.) on the salivary and vasomotor responses of the parotid and submaxillary glands in 18 dogs and 11 cats. The animals were either decerebrated or anesthetized with chloralose, ether,

morphine, or urethane. Wharton's duct was cannulated, the secretion measured with a Gibb's drop-recorder, and the composition of saliva determined.

Intravenous administration of BaCl₂ produced salivation in both cats and dogs which was augmented by pre-injection chorda tympani stimulation or by repeated injection of BaCl₂. BaCl₂ did not augment the secretion activated by stimulation of the sympathetic nerve to the gland nor by injection of adrenalin. Salivation activated by BaCl₂ was found to be abolished by atropine; salivary flow was restored by the administration of physostigmine. BaCl₂ saliva was similar in composition to that activated by chorda stimulation but was somewhat richer in solids.

Stavraky, George W., 1942. THE MECHANISM OF THE SYNERGISTIC ACTION OF PILOCARPINE AND ADRENALINE ON SALIVARY SECRETION. *Rev. canad. de Biol.*, 1 (1): 64-71. In English, with French summary.

The way in which pilocarpine sensitizes the submaxillary gland to adrenaline was studied in cats.

"1. Adrenaline injected intravenously in small doses of 0.01 mgm. or less in the cat does not elicit a secretion from the submaxillary gland; however, such doses markedly increase a precurrent secretion induced by small doses of pilocarpine, eserine or mecholyl.

"2. This synergistic action of parasympathomimetic substances and adrenaline is believed to be due largely to the vasodilatation produced in the gland by the latter drug and consequent increased diffusion of the former substances.

"3. When administered in large doses, adrenaline causes constriction of the glandular blood vessels and at the same time inhibits the secretion induced by parasympathomimetic substances.

"4. Relations similar to those described for the submaxillary gland prevail also in the parotid gland, though this organ is less sensitive both to parasympathomimetic stimuli and to adrenaline." (Author's summary.)

Stealy, Clair L., 1928. THE CLINICAL VALUE OF THE SALIVARY UREA INDEX. *Jour. Lab. clin. Med.*, 14 (2): 162-165.

Seventy-five estimations were made of the urea nitrogen content of saliva and the blood urea nitrogen in normal and pathologic cases. In the normal cases the salivary urea index and the actual blood urea nitrogen checked closely while large and varied discrepancies were noted in the pathologic cases. It is concluded that the salivary urea nitrogen determination cannot be used as an accurate indicator of cases to be further studied for renal impairment.

Stein, John B. and Claus F. Hinck, 1930. REACTIONS OBTAINED IN THE ORAL CAVITY. *Dental Cosmos*, 72 (8): 842-846. Colorimetric measurements of the pH of saliva of 184 persons were made at various points in the mouth and throat of each individual over a 3-day period. Reactions were determined at 7 AM, 1 PM, 7 PM, and midnight; always before meals and before rinsing the mouth or brushing the teeth. Results show a lack of uniformity in pH between individuals and for different parts of the mouth. The floor of the mouth was found generally more alkaline than the

upper mouth. A periodicity was noted in acid and alkaline values, the highest percentage of acidities being reported at 7 AM, dropping sharply in the following 6 hours, and then showing a tendency to rise between 7 PM and midnight. The periodicity of acid reaction is attributed to increased activity of oral bacteria and decreased salivation during the night.

Stephan, Robert M., 1944. INTRA-ORAL HYDROGEN-ION CONCENTRATIONS ASSOCIATED WITH DENTAL CARIES ACTIVITY. *Jour. dental Res.*, 23 (4): 257-266.

The hydrogen ion concentration of the oral cavity was studied in 65 individuals, 5 of whom were free of caries. Subjects were instructed not to brush their teeth for 3 to 4 days prior to the pH determinations in order to obtain a representative oral bacterial flora. Tests were made 1 or more hours after mealtime. Direct pH determinations were made on the tooth surface with a polished-stick antimony electrode using a vacuum tube potentiometer. Measurements were also made of the pH on the gingival tissue, the cheeks near the parotid ducts, the floor of the mouth near the submaxillary ducts, and the dorsum of the tongue. The effect of carbohydrates on the pH was observed. The mouth was rinsed with 25 cc. of a 10% aqueous solution of glucose for 2 minutes following the initial pH determinations. The pH determinations were repeated 2 minutes after the glucose rinse and at 10-minute intervals thereafter until the pH had returned to approximately its original value.

Before the application of glucose rinse, the pH values were around neutrality. In all cases there was a sharp drop in the pH of the bacterial material on the teeth following rinsing the mouth with the glucose solution. There was also a sharp drop in the pH on the dorsum of the tongue following the glucose rinse.

In the caries-free group the pH of the saliva measured on the floor of the mouth averaged 7.0 (ranged from 6.8 to 7.4). The initial pH of the plaques (before glucose rinse) on the labial surfaces of the upper anterior teeth averaged 7.1 (ranged from 6.4 to 7.7), and of the labial surfaces of the lower anterior teeth averaged 7.2 (ranged from 6.7 to 7.5). The lowest pH of the plaques (after the glucose rinse) averaged 5.5 (ranged from 5.2 to 5.8) for the labial surfaces of the upper teeth, and for the labial surfaces of the lower teeth, averaged 6.1 (ranged from 5.6 to 6.7).

It is concluded that (1) the bacterial plaques which are capable of producing acid rapidly grow not only on the teeth of individuals who have active caries, but also on the teeth of those who are caries-free; (2) that the presence of carbohydrates in the mouth appears to be essential for the production of acid; and (3) that the accessibility of the tooth surfaces to a flow of saliva is an important factor in regard to the pH of the tooth surfaces.

Stephan, Robert M., and Elizabeth Hemmens, 1946. pH studies on oral micro-organisms. *Jour. dental Res.*, 25 (3): 172-173.

"Masses of micro-organisms growing on teeth produce a rapid drop in pH when carbohydrates

are ingested, but similarly rapid pH changes do not occur with the low microbial cell concentrations usually employed in acid production tests with culture media or saliva. In order to compare the ability of different micro-organisms to produce pH changes such as occur on teeth, pure cultures of micro-organisms isolated from plaques were grown, and concentrated by centrifugation in a buffer resembling saliva to approximately the concentration of microbial cells on teeth. A glass electrode was used to determine pH, and experiments were run at 37.5° C. [Of] 14 types of micro-organisms tested, almost all produced a rapid pH drop when carbohydrate was added, but only some gave a rapid pH rise when pyruvate, lactate, or urea was added as a substrate. Differences in pH curves occurred not only with different micro-organisms but also with different cell concentrations as well as with different substrates. The complex nature of these pH curves suggests that many more enzyme systems are involved in the caries process than merely those which produce acid." (Complete paper.)

Stephens, D. J., and Edgar Jones, 1934. LEUCOCYTES IN THE SALIVA IN NORMAL AND ABNORMAL SUBJECTS. *Proc. Soc. exper. Biol. Med.*, 31 (7): 879-880.

A report is given of 512 comparative counts of the leucocytes in saliva and blood of 20 normal and 17 abnormal individuals. No correlation could be found between the white cell counts of the two fluids of normal individuals; fluctuations of one or the other, or both at the same time had no consistent reciprocal relationship. Likewise, when the salivary and blood leucocyte counts were made simultaneously no correlation existed between the two in myelogenous leukemic patients being treated with Roentgen ray irradiation and Fowler's solution, or in patients suffering from agranulocytic angina, thrombocytopenic purpura with granulocytopenia, carcinoma of the stomach or breast, Hodgkin's disease, lymphatic leukemia, and lobar pneumonia.

In 50% of the normal persons the salivary leucocytic counts were below 25 cells/mm³, however, counts ran as high as 1000/mm³.

Stern, Albert R., 1931. THE HYDROGEN-ION CONCENTRATION OF NORMAL RESTING SALIVA IN CHILDREN, AND ITS RELATION TO DENTAL CARIES. *Dental Cosmos*, 73 (10): 1017-1018.

Determination, by colorimetric methods, of the pH of normal unstimulated saliva in 100 children showed the pH to vary from 6.6 to 7.0 and to have an average value of 6.8. It is suggested that the buffer action of the saliva prevents too high an acidity in the mouth.

Sticker, Georg, 1889. DIE BEDEUTUNG DES MUNDSPICHELNS IN PHYSIOLOGISCHEN UND PATHOLOGISCHEN ZUSTÄNDEN [The significance of mouth saliva in physiological and pathological conditions]. *Deutsche Med.-Zeitung*, 10 (1): 1-3; (2): 12-14; (3): 25-28; (4): 39-40; (5): 49-51; (6): 61-63; (7): 73-75; (8): 85-86; (9): 97-100; (10): 111-113; (11): 123-125; (12): 137-139; (13): 147-149; (14): 159-161; (15): 171-173; (16): 186-187; (17): 195-197; (18): 209-212.

The acidity and alkalinity of mixed human saliva of a number of persons was studied at different times of the day and night and under various conditions.

Stozharov, B. I., 1949. O VLIJANII KORKOVOGO PISHCHEVOGO TSENTRA NA BEZUSLOVNUIU REAKTSIU [On the influence of the cortical food center on the unconditioned reaction]. Trudy fiziol. Lab. I. P. Pavlova, 15: 30-39.

Study of conditioned and unconditioned reflex salivation was continued in 4 dogs having parotid fistulas. Saliva was stimulated by 5 feedings of rusk-meat powder and samples collected every 30 seconds. Results show the unconditioned salivary response to be greatest in the second consecutive 30-second sample collected during the early part of an experimental day; toward the end of a day the initial 30-second sample increased in volume to that of the non-varying second sample so that salivary flow was more rapid and ceased more quickly than at the start. The salivary rate in the first sample period increased and became largest in 3 of the 4 dogs on establishment of a conditioned salivary reflex in the animals, when conditioned stimulation was given 2 minutes before food stimulation. No change occurred in unconditioned, food-stimulated salivary flow when a 10-minute interval separated administration of the two stimuli. Interaction of conditioned and unconditioned reflexes and cortical influence on response are discussed.

Stralfors, Allan, 1948. STUDIES OF THE MICROBIOLOGY OF CARIES. III. The buffer capacity of the dental plaques. Jour. dental Res., 27 (5): 587-592.

"The buffer capacity of dental plaques has been determined and compared with that of the saliva. It is found that the buffering is greater in the plaque than in the saliva, especially at the lower pH values. The importance of this fact to the understanding of the caries is discussed. It is suggested that the plaque has the ability to store the acid and to hinder the saliva from neutralizing it. It is showed that there is great resemblance between the buffering of the plaque and the sediment from centrifuged saliva." (Author's summary.)

Strongin, E. I., L. W. Hinsie, and M. M. Harris, 1938. STUDIES IN PAROTID SECRETION OF PATIENTS BEFORE, DURING AND AFTER INSULIN HYPOGLYCEMIC THERAPY. Psychiat. Quart., 12 (3): 506-513.

The parotid salivas of 10 dementia praecox patients were studied before, during and sometimes after insulin hypoglycemic treatment; determinations were made of the rate of secretion (method similar to that of Lashley, 1916m) and of potassium (modification of the Truszkowsky and Zwemer method), chloride (the Claudius ultramicroapplication of the open carius method), and protein (modified Denis and Ayer method for cerebrospinal fluid).

"1. The general secretory level of parotid saliva, after a series of insulin hypoglycemic treatments, dropped considerably below the secretory level during the trial period, with the exception of ... one case.... In the latter

case a rise of secretory rate associated with regression in psychiatric conditions was found.

"2. The secretory level during the hypoglycemic state showed a sharp rise with the onset of stupor and coma. However, sleep, which often occurs soon after insulin administration, has the opposite effect, namely, a drop in secretory level.

"3. As the secretory rate increased, a drop in the potassium and chloride concentrations occurred, this drop tending to reach a plateau beyond which further increases in rate resulting from the hypoglycemic state produce little effect.

"4. The increase in rate occurring during insulin hypoglycemia was accompanied by a pronounced increase in cloudiness of the secretion together with a rise in its protein content. These were first manifested at the onset of stupor and became more pronounced during coma." (Authors' summary.)

Strongin, Edward I., and Leland E. Hinsie, 1938a. PAROTID GLAND SECRETIONS IN MANIC-DEPRESSIVE PATIENTS. Amer. Jour. Psychiat., 94 (6): 1459-1466.

The results of this study indicate that the parotid gland salivation rate of manic patients lies within the normal range, (.02-.15 cc.), while the secretory rate is lower than normal for patients in a depressed mental state. Detection of the resultant hydrogen ion concentration revealed that as the secretory rate increases the pH rises and as the salivary rate decreases the pH falls. The discussion section consists of commentaries by reviewers, and includes a discussion of previous findings and several pertinent questions regarding experimental and non-experimental factors related to or affecting this study.

Strongin, Edward I., and Leland E. Hinsie, 1938b. PAROTID SECRETORY RATE IN SCHIZOPHRENIC PATIENTS. Jour. Nerv and mental dis., 87 (6): 715-724.

The parotid secretory rates were measured in both psychotic and normal persons, and the results compared. All individuals' movements were kept at a minimum in an attempt to avoid external stimulation. The first group (group A), consisting of "normal" persons, showed an average secretion for 5 minutes over a two hour period of .07 cc., with variations of .02 to .15 cc. Group B or late psychotics, consisting of 4 hebephrenics and 1 hebephrenic-catatonic, revealed an average secretory volume-rate of .38 cc., with extremes of .23 cc. and .74 cc., for every 5 minutes over a two hour period. Group C or the early psychotics (3 early hebephrenics, 1 manic-depressive, and 1 compulsive-obsessive showed an average of .005 cc., with extremes of .002 cc. and .007 cc. over the same time period.

It is suggested that those changes resulting in the mental conditions may also be responsible for the secretory differences noted above.

Stuteville, O. H. 1935. PRESENCE OF VITAMIN C IN SALIVA. Proc. Soc. exper. Biol. Med., 32 (9): 1454-1455.

A method for the determination of Vitamin C in saliva is described.

Seven and one-half cc. of paraffin-stimulated saliva were acidified with 2.5 cc. of 20% tri-chloroacetic acid and filtered. 2 cc. of the filtrate were titrated with 2-6-dichlorophenolindophenol until a definite pink color appeared, which was then compared with a standard ascorbic acid solution.

The titration was not affected by KSCN.

When a guinea pig (previously depleted of Vitamin C, having scurvy, and declining in weight) was given a dietary supplement of 4 cc. of saliva (containing 0.010 mg. Vitamin C) each day for two weeks, followed by 8 cc. for 11 days, the life of the animal was prolonged and the body weight was maintained above the initial value. The scurvy was not cured.

Sugg, John Y., and James M. Neill, 1931. LOSS OF IMMUNE SUBSTANCES FROM THE BLOOD. II. Diphtheria antitoxin in human saliva. *Jour. Immunol.*, 20 (6): 463-481.

A study was made of the ratio between diphtheria antitoxin of the saliva and of the serum of 33 persons, one of whom was toxoid-immunized and the remaining 32 of whom were selected from a group of 4,000 persons after routine tests of their sera showed the presence of 2.0 units or more of "natural" antitoxin.

Saliva was collected (7 to 10 cc.) in mid-morning by persons spitting into wide-mouthed test tubes, without any means of stimulating salivary flow. Samples were examined macroscopically for freedom from blood cells. No adjustment of the pH was necessary, since it ranged between 7.0 and 7.4, because of the loss of CO₂. Samples were centrifuged to remove debris and bacteria, and heated at 55 C°, for 30 minutes. Blood samples were usually taken on the same day, and always within the same week, as the individual's saliva sample.

The method of intradermal injection of guinea pigs with mixtures of toxin and sterile saliva was the same as used in an earlier study of this series (Neill, J.M., E.L. Gaspari, and R.A. Mosley, 1931. *Jour. Immunol.*, 20:347) on urine. The skin reactions of the guinea pigs injected intradermally with the prepared saliva, were compared with those induced by a similar injection of a standard toxin mixture containing 0.002 L+ per 1.0 cc.

The concentration of antitoxin in the saliva was directly related to the concentration in the blood. The average ratio between the saliva antitoxin and the serum antitoxin of this group of 33 people (Table 4) was 1.4×10^{-3} ; the ratios of 82% of the group were within the range of 0.50 to 2.0×10^{-3} . In spite of the wide range in serum antitoxin concentrations (1.25 to 60.0 units per 1 cc.) occurring in the group of persons studied, the ratio remained of the same order of magnitude.

It was estimated that during a year's time the antitoxin swallowed with the saliva would be equivalent to approximately 25% of the total amount in the blood. Unless reabsorption occurs, the gastrointestinal tract must be considered as an important channel of loss. Since *in vitro* experiments have shown that antitoxin can be destroyed by the pepsin of the stomach and by enzymes and bacteria of the intestines, reabsorption is quite unlikely.

Sulkin, S. Edward, and Carl G. Harford, 1943. CONCERNING THE INFECTIVITY OF SALIVA IN

HUMAN RABIES. *Ann. internal Med.*, 19 (2): 256-262.

The saliva of three cases of thirteen patients suffering from rabies infection was processed (using immunologic, serum neutralization, and specific serum tests) to determine the presence or absence of the rabid virus. The virus, of a sufficient titer to cause subsequent infection of experimental animals, could only be detected by the methods used in the saliva obtained from patients undergoing convulsive seizures, at which time the salivary secretion was copious. Although the rabid virus cannot be detected in every sample of saliva taken from infected persons, it is suggested that the necessary infection-prevention precautions be utilized by those individuals in contact with rabid subjects or who may be exposed to the salivary secretions of such persons.

Sullivan, June H., and Clara A. Storrick, 1950. CORRELATION OF SALIVA ANALYSES WITH DENTAL EXAMINATIONS OF 574 FRESHMAN AT OREGON STATE COLLEGE. *Jour. dent. Res.*, 29 (2): 165-172.

Analyses of paraffin-stimulated salivas were made of 574 freshmen at Oregon State College, consisting of determinations of pH, starch-hydrolyzing time, buffer capacity, ammonia nitrogen, and lactobacillus plate counts. Highly significant correlations were found between DMF surfaces (total number of tooth surfaces decayed, missing or filled) and lactobacillus counts and between DMF surfaces and starch hydrolyzing time. Direct correlations were also observed between DMF and pH, between pH and buffer capacity, between buffer capacity and starch-hydrolyzing time, and between ammonia nitrogen and pH. Inverse correlations occurred between DMF surfaces and buffer capacity and between lactobacillus plate counts and buffer capacity. No significant correlation was observed between DMF surfaces and ammonia nitrogen. Three tables of values are presented.

Sullivan, June H., and Clara A. Storvick, 1950a. STATISTICAL INTERPRETATION OF SALIVARY ANALYSES ON 555 SCHOOL CHILDREN IN TWO GEOGRAPHICAL REGIONS IN OREGON. *Jour. dent. Res.*, 29 (2): 173-176.

Salivary analyses, consisting of determinations of pH, buffer capacity, amylase activity (measured as starch-hydrolyzing time), lactobacillus counts, ammonia nitrogen, and acid-producing power of the oral flora as measured by the Snyder test (described in full), were made on 555 school children. Differences between ages (14 to 16 years), sexes, and geographical areas (4 counties) were studied.

Significant county variations were observed in mean pH (ranging from 7.25 to 7.42), in buffer capacity (from 0.63 to 0.84), in ammonia nitrogen (from 3.94 to 6.02 mg./100 ml.), and in lactobacillus counts (2.94 to 3.86); method of lactobacillus counting and coding is given.

The most significant difference in regard to age or sex occurred in buffer capacity between sexes in each county. With one exception, the mean buffer capacity of the males was higher than that of the females. In the one exception (14-year-olds in one county), the buffer capacity mean for the males was the same as for the females.

Calculations of correlation coefficients between the various combinations of tests were made. Significant direct correlations occurred between

lactobacillus counts and acid production, and between pH and buffer capacity. Significant negative correlations were observed between ammonia nitrogen and lactobacillus counts, and between ammonia nitrogen and acid production.

The studies support the results of previous investigations (cf. Sullivan, 1950m).

Sullivan, M. X. and K. K. Jones, 1919. BIO-CHEMICAL STUDIES OF THE SALIVA IN PELLAGRA. Publ. Health Rep., 34 (20): 1068-1080.

A study was made of the salivary changes accompanying pellagra, and it was noted that the quantity of salivary secretion increases when the mouth and tongue are involved. Generally, however, the rates of salivary flow of pellagra patients varied within normal limits. The pathological saliva resembles sympathetic saliva in that it was viscous, ropy, and turbid.

Chemical determinations revealed that the specific gravity, alkalinity, and contents of total solids, ash, organic matter, mucin, sulphocyanate, phenols, uric acid, and indican were higher in pellagrins than in normal controls. However, the diastatic power of pellagrins was not affected by the disease.

Summerson, William H., and Isaac Neuwirth, 1941. THE PRODUCTION OF ACIDS FROM GLUCOSE BY ORAL MICROORGANISMS. Jour. dental Res., 20 (2): 157-158.

"This is a study by chemical and micromanometric methods of the production of acid from glucose by oral microorganisms in saliva as a medium. The saliva containing the mixed oral microorganisms was obtained by paraffin stimulation from subjects with dental condition varying from severe involvement to absence of caries. The experiments were carried out by incubation with added glucose in the Warburg apparatus at 37° for 15 or 30 minute periods, using a differential manometer for the precise determination of the total acid produced, and improved chemical methods for the subsequent analytical study of the individual acids present. It was found in all cases studied that lactic acid production accounted for only 50 per cent or less of the total acid produced, with no significant differences in this respect between carious and non-carious individuals. Pyruvic acid was occasionally found in small amounts, but lactic and pyruvic acid together in no way account for the total acid produced. The nature of the extra acid or acids is under investigation." (Complete paper.)

Swanson, A. A., 1957. IS COLLAGENASE FOUND IN SALIVA FROM PERIODONTAL DISEASED MOUTHS? Jour. dent. Res., 36 (5): 717-720.

Seitz saliva taken from mouths of patients with periodontal disease does not possess the property of breaking down gelatin, azocoll, or unaltered rat tail collagen. The proteolytic activity of collagenase upon collagen paper is confirmed. (Author's summary)

Swanson, A. M. 1917. CONTRIBUTIONS TO THE PHYSIOLOGY OF THE STOMACH. XLI. The alleged influence of the removal of the salivary glands on the secretion of gastric juice. Amer. Jour. Physiol., 43 (2): 205-211.

The salivary glands of 2 dogs were extirpated in an investigation of a possible hormone in the saliva stimulating the secretion of gastric juice. Extirpation of the glands caused a distinct rise in the acidity of the gastric juice. The rate or quantity of secretion of gastric juice in both dogs was not altered by removal of the salivary glands. The results are considered to contradict the theory of a salivary hormone which stimulates the secretion of gastric juice.

Swerdlove, Carlton K., 1942. RELATION BETWEEN THE INCIDENCE OF DENTAL CARIES AND THE pH OF NORMAL RESTING SALIVA. Jour. dent. Res., 21 (1): 73-81.

Colorimetric determinations were made of the unstimulated salivas of 351 male freshman dental students, 19 to 25 years of age. The salivary pH was found to vary from 6.0 to 7.4 and have a mean of 6.69. A second mean of 6.72, determined in a second investigation, did not vary significantly from the first. Dental records used to determine the incidence of dental caries showed this incidence to vary between 0 and 58. No significant correlation was found between the salivary pH and the caries index.

Sychev, N. A., 1949. O VLIYANIÍ RTUTI NA PARASYMPATICHESKUIÚ INNERVATSIIÚ PODCHELIÚSTNOI SLIÚNNOI ZHELEZY SOBAKI I KOSHKI [On the influence of mercury on the parasympathetic innervation of the submaxillary gland in the dog and in the cat]. Sbornik Trudov Teoret. Kafedry Arkhangel'. Med. Instit., 9: 124-132. Sovet. med. refer. Obozrenie, 1950 (7): 147.

The influence of mercury compounds on salivary secretion was studied in the denervated submaxillary glands of cats and dogs. Intravenous injection of these compounds does not elicit salivary secretion from the denervated glands; nor does it substantially affect pilocarpine salivation, if applied at a dose that does not stop the heart-beat or affect respiration. Injection of these compounds noticeably increased salivary secretion in the normal gland under faradic chordal stimulation in every experiment. The mercury appears to combine with the cholinergic structure of the secretory cell, raising its sensitivity to acetylcholine, the mediator of the cholinergic fibers.

Tauber, Henry and Israel S. Kleiner, 1933. THE DIGESTION AND INACTIVATION OF MALTASE BY TRYPSIN AND THE SPECIFICITY OF MALTASES. Jour. gen. Physiol., 16 (5): 767-771.

Experimentation showed that both the maltase of human saliva and that of *Escherichia coli* hydrolyze only maltose and are readily inactivated and digested by trypsin. From this, the authors suggest that those maltases should be considered gluco-maltases.

Tauber, Henry, and Israel S. Leiner, 1934. THE INACTIVATION OF PEPSIN, TRYPSIN, AND SALIVARY AMYLASE BY PROTEASES. Jour. biol. Chem., 105 (2): 411-414.

In the course of a study on the digestibility of various enzymes by proteolytic enzymes, the digestion of salivary amylases by trypsin and papain was investigated. 3 cc. of 0.2 M phosphate buffer (pH 7.2) were added to 15 cc. of 0.3% trypsin solution (pH 7.2). The same amount of buffer was added to 15 cc. of filtered saliva (pH 7.2). Equal amounts of trypsin solution and of

the saliva were mixed and tested at intervals. The amylolytic activity was indicated by the iodine-starch color test and quantitatively measured by the method of Waldschmidt-Leitz et al., 1923.

After 48 hrs., 28% of the amylase was digested by the trypsin; after 96 hrs., 50% was inactivated. With the H₂S-activated papain at a pH of 7.0, digestion of the amylase was much slower.

Taylor, Walter E., and Basil G. Bibby, 1935. BACTERICIDAL PROPERTIES OF HUMAN SALIVA. Jour. dental Res., 15 (3-4): 178-179. [Abstract].

Samples of saliva from 5 individuals had no antibacterial effects upon the pneumococci, hemolytic streptococci, or the influenza bacilli tested. In a comparison of salivary effects upon Micrococcus lysodeikticus and Lactobacillus acidophilus, it appeared that two different inhibitory principles were involved: One, active against M. lysodeikticus, was removable by filtration through a Berkefeld-N filter, could be concentrated by moderate centrifugation, was soluble in 0.9 saline, resisted heat for 15 minutes at 73° C., and induced lysis of organisms in a liquid medium. The other principle, affecting L. acidophilus, had none of these properties and was destroyed in 5 minutes at 70° C.

Teague, Oscar, 1913. SOME EXPERIMENTS BEARING UPON DROPLET INFECTION IN DIPHTHERIA. Jour. infect. Dis., 12 (3): 398-414.

The epidemiological importance of the inhalation of droplets of saliva in the spread of diphtheria was studied. Cultures were made of the saliva of diphtheria patients, and of droplets emitted in talking and coughing. The diphtheria bacillus [Corynebacterium diphtheriae] was found to be present in these cultures but usually in small numbers.

Tekutov, P. E., 1937. O SOOTNOSHENII USLOVNOGO I BEZUSLOVNOGO SLIUNOOTDELITEL'NYKH REFLEKSOV [On the correlation of the conditioned and unconditioned salivary reflexes]. In VII Kavkaz. S"ezd Fiziol., Biokhim. i Farmakol. v Krasnodare, 1937, p. 46.

Changes in the unconditioned salivary reflex and its correlation to the conditioned reflex values were studied in 11 dogs. Hydrochloric acid and rusk powder were used as stimulants. The salivary secretion was measured by the air transmission method. Hasen's experiments were repeated and served as a basis for the study. The following conclusions were reached.

Between the unconditioned and the spontaneous conditioned reflexes a direct or a reverse correlation is observed. Between the unconditioned and the artificial conditioned reflex only a possible direct quantitative correlation exists. The extinction of the spontaneous conditioned reflex does not diminish the value of the unconditioned.

Some dogs have stable reflexes, others show variable values in food and defense reflexes. During one experiment the reflex may drop, or increase, or it may both increase and decrease in the same dog.

Prolonged administration of acid or sodium produced no other changes than an occasional decrease in the reflex.

At the end of the experiments in dogs with resected esophagus, either an increase or a

decrease of the unconditioned acid reflex was observed. [From author's abstract]

Tenenbaum, Benjamin, and Maxwell Karshan, 1937. FACTORS IN SALIVA CORRELATED WITH OCCURRENCE OF SALIVARY CALCULUS. Jour. dental Res., 16 (4): 305.

Three portions of paraffin-stimulated saliva were collected from each of 49 persons (29 calculus-free and the remainder having varying degrees of calculus deposits). The first portion was used for determination of initial pH; the second portion, for P, Ca, and protein determination; and the third, for a second pH determination.

Mean values for Ca and P were higher in the calculus group than in the calculus-free one. A significant difference occurred in the calcium means for each group; the difference in phosphorus was probably significant.

The mean protein content was higher and the mean pH values were lower in the calculus-free than in the calculus group; neither difference was statistically significant.

The data indicated a relationship between Ca, and probably also P, levels of the saliva and the occurrence of calculus deposits.

Tenenbaum, Benjamin, 1937a. FACTORS IN HUMAN SALIVA CORRELATED WITH THE OCCURRENCE OF SALIVARY CALCULUS. Jour. Amer. dental Assoc., 24 (8): 1255-1259.

Paraffin-stimulated saliva samples from 49 persons (20 calculus-free and 29 with varying degrees of calculus) were examined in an effort to determine a relationship between salivary pH, calcium, inorganic phosphate, and protein with the tendency to form calculus. For calcium determinations, the method of Krasnow (1932) was employed; for phosphate determinations, that of Tisdall (Jour. Biol. Chem., 50: 329. 1922.); and for protein, that of Karshan (1936). The pH was determined colorimetrically. The mean value of calcium was lower in the calculus-free group (5.1 mg./100 cc.) than in the calculus group (6.7); similar results were obtained for inorganic phosphate (11.8 and 13.6 mg./100 cc., respectively) and for pH (6.99 and 7.09, respectively, for the first saliva sample, and 7.21 and 7.3 for the second sample). The reverse was true for protein (314 and 294 mg./100 cc. saliva). Because of the variability within each group, values for mean pH and mean protein content were not considered statistically significant.

Tenenbaum, Benjamin, and Maxwell Karshan, 1938. FACTORS IN UNSTIMULATED SALIVA CORRELATED WITH CALCULUS. Jour. dental Res., 17 (4): 334.

Saliva samples of 46 persons (14 calculus-free, the remainder having various degrees of deposits) were collected in three successive portions, 1 to 3 hours after breakfast. The first portion (1 cc.) was used for initial pH determination; the second (5 to 6 cc.), for Ca, P, and protein determinations; and the third (1 cc.), for final pH. In general, the mean values for the calculus-free group were less than for the calculus group. In the calculus-free group, values for calcium were 5.6 mg./100 cc. and for P, 16.8 mg./100 cc., in the calculus group, 6.5 mg./100 cc. for Ca, and 19.2 mg./100 cc. for P.

The differences in pH and protein were less noteworthy. In the calculus group, the initial

pH was 6.80, the final pH, 6.88, and the protein content, 320 mg./100 cc.; in the calculus-free groups, the values were 6.75, 6.86, and 306 mg./100 cc. respectively.

Tenenbaum, Benjamin, and Maxwell Karshan, 1939. FACTORS IN SALIVA CORRELATED WITH THE OCCURRENCE OF CALCULUS. Jour. Amer. dental Assoc., 26 (12): 1965-1971.

Chemical analyses of stimulated and unstimulated saliva samples from persons having dental calculus were compared with those of calculus-free individuals, in an attempt to determine the salivary factors related to calculus formation.

Significant differences in mean calcium values occurred between the two groups of individuals--the means for the calculus-free group (5.1 mg./100 cc. stimulated saliva and 5.6 for unstimulated) being lower than those of the calculus group (6.7 and 7.1, respectively). Similarly, differences in the mean values for inorganic phosphate between the calculus-free group (11.9 mg./100 cc. for stimulated saliva and 17.1 for unstimulated) and the calculus group (13.9 and 19.8, respectively) were statistically significant. Protein and pH differences were insignificant, with the exception of the difference between the initial and final pH of stimulated saliva (7.00 and 7.23, respectively, for the calculus-free group, and 7.12 and 7.33, for the calculus group). When salivary values before and after dental prophylaxis were compared, there was little difference, indicating that "the findings reflect the tendency toward calculus formation rather than the effects of the presence of calculus."

Tenenbaum, Benjamin, and Maxwell Karshan, 1942. SALIVARY STUDIES IN PERIODONTOLASIA. Jour. dental Res., 21 (3): 311.

A comparison was made of the chemical constituents of stimulated and unstimulated salivas of 38 patients (10 calculus-free and 28 having heavy deposits of calculus).

For unstimulated saliva, mean values per 100 cc. in the calculus-free group were: Ca, 5.6 mg.; inorganic P, 17.5 mg.; protein, 383 mg.; CO₂-combining power, 6.9 cc.; initial and final pH, 6.65 and 6.86 respectively; and time for collection of 10 cc. saliva, 34.5 [minutes?]. For the calculus group, mean values per 100 cc. saliva were: Ca, 7.0 mg.; inorganic P, 19.7 mg.; protein, 394 mg.; initial and final pH, 6.54 and 6.91 respectively; CO₂ combining power, 7.6; and time for collection of 10 cc. saliva, 30.4.

For stimulated saliva, the mean values per 100 cc. in the calculus-free group were: Ca, 5.2 mg.; inorganic P, 11.3 mg.; protein, 280 mg.; initial and final pH, 7.20 and 7.49 respectively; CO₂ combining power, 29.6; and the time for collection of 10 cc. saliva was 8.9. In the calculus group, the mean values were: Ca, 6.8 mg.; inorganic P, 13.5 mg.; protein, 301 mg.; initial and final pH, 7.20 and 7.46; the CO₂ combining power, 29.1 mg.; and the time for collection of 10 cc. saliva was 9.0.

Terrill, P., and L. S. Fosdick, 1948. THE METHOD FOR MEASURING THE AMINO ACID IN SALIVA AND SALIVARY PROTEINS. Jour. dental Res., 27 (6): 739.

"In 1943 Consdon of England devised the method of separating amino acids by means of partition chromatography using columns of silica gel. He mentioned that separations could be made simply by the use of filter paper strips and by using phenol-water or, in some cases, butyl alcohol-water mixtures as the partition fluid. This method was tested in relation to the separation of amino acids in saliva and salivary hydrolysates, and it was found that amino acids in a concentration of from two to fifty gamma could be detected. Furthermore, by developing a color on the paper strips by means of ninhydrine, a quantitative separation and identification could be effected. The amino acid concentration in freshly secreted saliva is extremely low, and in most cases beyond the sensitivity of this method, but the amino acid concentration in salivary hydrolysates and putrefied saliva can readily be detected." (Complete paper.)

Teuscher, George W., and L. S. Fosdick, 1937. RETENTION OF REDUCING SUGARS IN SALIVA AFTER MASTICATION OF CARBOHYDRATES. Jour. Dental Res., 16 (4): 354.

"Number of bacteria and retained amount of carbohydrate, in mouth, possible factors in caries. Semiquantitative determination (Benedict solution) of sugar retention, after meals and ingestion of candy (85 boys): gradual disappearance of sugar from saliva after consumption of various sugar-containing foods, rate of removal varying with individuals--those more susceptible to dental caries retained sugar longer. Effect, on mixed saliva, of ingestion of sugary desserts and candy: "larger percentage of sugar remained longer time." (Author's abstract)

Thompson, F. C., and Finn Brudevold, 1951. A MICRO ANTIMONY ELECTRODE SUITABLE FOR INTRAORAL pH MEASUREMENTS. Jour. dental Res., 30 (4): 523.

"A micro antimony electrode has been developed which is sealed within glass tubing of an outer diameter of about one millimeter. A piece of the glass tubing containing antimony is heated until the metal liquefies, and since the glass becomes soft at the melting point of antimony, the tubing may be drawn to any desired dimension. The tube containing the solidified antimony may be reheated and given any convenient shape. A small portion of glass is ground away at the working end, and the protruding antimony is highly polished to a point. A silver wire, heated and embedded in the antimony at the other end of the electrode connects it with the shielded wire of the pH meter. The accuracy of the micro electrode is within 0.2 pH units in the range pH 4 to 7.5. The electrode may be employed in the determination of pH values in various lesions, interdental spaces, and periodontal pockets. With a capillary KCl bridge it is also suitable for studying the decalcification of minute areas of the enamel surface." (Complete paper.)

Thompson, F. Clarence, and F. Brudevold, 1954. A MICRO-ANTIMONY ELECTRODE DESIGNED FOR INTRAORAL pH MEASUREMENTS IN MAN AND SMALL EXPERIMENTAL ANIMALS. Jour. Dental Res., 33 (6): 849-53.

Details are given concerning the construction and method of use of a micro-antimony electrode having an outer diameter at the working end of 0.6 to 0.7 mm. Salivary measurement made in the mouth were found to vary from pH 6.5 to 7.2. When the point of the electrode was brought in contact with mucous membrane, involving electrode motion and consequent erroneous pH readings, higher pH values (up to 8.9) were often obtained.

Thompson, Richard, 1940. LYSOZYME AND ITS RELATION TO THE ANTIBACTERIAL PROPERTIES OF VARIOUS TISSUES AND SECRETIONS. Arch. Path., 30 (5): 1096-1134.

A very extensive review of the literature on bacteriolytic agents in tissues and secretions, including oral tissues (i.e. lysozyme, inhibines, beta lysins, etc.), is presented. 159 refs.

Thompson, Richard, 1941. CERTAIN ANTIBACTERIAL PROPERTIES OF SALIVA AND TEARS NOT DUE TO LYSOZYME. Jour. Bacteriol., 41 (1): 77.

Saliva samples were divided into two portions each - one a control, the other filtered, or acidified and heated for 5 minutes. After neutralization, a test was made of the treated portions and of the controls for lysozymic activity against other organisms. Lysozymic activity was determined by photoelectric measurement of turbidity diminution in micrococcal suspensions and by observations of inhibition areas around drops on agar cultures of micrococci.

In acid solutions, the lysozyme of saliva was resistant to heating at 100°C. for 5 minutes, while the antibacterial principles of saliva against other than lysozyme-sensitive saprophytes (diphtheria bacilli, lactobacilli, hemolytic streptococci and staphylococci) were destroyed.

Thompson, Richard, and Madoka Shibuya, 1946. THE INHIBITORY ACTION OF SALIVA ON THE DIPHTHERIA BACILLUS: THE ANTIBIOTIC EFFECT OF THE SALIVARY STREPTOCOCCI. Jour. Bacteriol., 51 (6): 671-684.

The inhibitory action of saliva on diphtheria bacilli is due entirely to inhibitory organisms present in it. Experimentation on *Corynebacterium diphtheriae* showed undiluted saliva to have no inhibitory action, while the action of the diluted saliva is due to salivary streptococci. Of 115 bacteria tested, 52 showed inhibitory properties and all were streptococci. Experimentation on 27 inhibitory strains of streptococci showed 24 strains to be of Sherman's mitis type. Attempts to remove these streptococci (while preserving the inhibitory action of the saliva) by heat, filtration, centrifugation, and the bactericidal effect of copper, proved unsuccessful. The inhibitory actions of the saliva and of the pure cultures of mitis streptococci were increased by dilution associated with greater growth of streptococci. The presence of staphylococci in the saliva antagonized the inhibitory action of the streptococci.

Thompson, Richard, and Ann Johnson, 1947. THE INHIBITORY ACTION OF SALIVA ON THE DIPHTHERIA BACILLUS: HYDROGEN PEROXIDE, THE ANTIBIOTIC AGENT OF SALIVARY STREPTOCOCCI. Jour. Bacteriol., 54 (1): 53-54.

"Since the inhibitory action of saliva on *Corynebacterium diphtheriae* was shown to be due to viridans streptococci, we studied the role of hydrogen peroxide in this inhibition and the role of catalase in the staphylococcal antagonism of it. Drops of material to be tested were placed on four plates containing diphtheria bacilli. Hydrogen peroxide was detected by benzidine or o-tolidine and potato. Catalase was detected by breakdown of hydrogen peroxide and recognized by gas production or by titration by permanganate. Seventy-one strains of salivary streptococci produced peroxide and inhibited diphtheria bacilli. The degree of inhibition was correlated with the concentration of peroxide produced. Several strains grown in deep broth produced no peroxide and filtrates of these cultures were not inhibitory. The same cultures, shaken for 10 minutes while exposed to air, produced large amounts of peroxide and their filtrates inhibited the bacilli. Seventeen strains of streptococci produced neither detectable peroxide nor appreciable inhibition. Thirty-four strains of staphylococci produced neither inhibition nor peroxide but produced catalase and antagonized the inhibitory actions of saliva and streptococci. Potato juice and lysed erythrocytes also antagonized these actions. Additional strains of diphtheria bacilli, pathogenic and nonpathogenic staphylococci, and enteric bacilli were tested for inhibition by saliva, streptococci, and peroxide. The order of sensitivity was the same to all three agents, diphtheria bacilli being the most sensitive and enteric bacilli the least. The inhibitory action of saliva against diphtheria bacilli is largely due to hydrogen peroxide produced by the salivary streptococci." (Complete paper).

Thomson, David and R. Thomson, 1932. THE COMMON COLD WITH SPECIAL REFERENCE TO THE PART PLAYED BY STREPTOCOCCI, PNEUMOCOCCI, AND OTHER ORGANISMS. Ann. Pickett-Thomson Res. Lab., 8: 1-737.

Literature concerning the nose and nasal sinuses as well as on the physiology, bacteriology, and chemistry of the mouth and saliva is extensively reviewed.

Thomson, David, and Robert Thomson, 1932. THE COMMON COLD. VIII. THE PHYSIOLOGY AND CHEMISTRY OF THE MOUTH AND SALIVA. Ann. Pickett-Thomson Res. Lab., 8: 48-55, 624-626.

An extensive, but general, review of literature is presented concerning various physical and chemical aspects of saliva, as well as a brief description of the histology and glandular secretions of the tongue and mouth. The cleansing action of the mouth, in which saliva plays a major role, is discussed, and is followed by a description of the nature, reaction, and composition of salivary secretions.

The acid, alkaline, and buffer salivary reactions, variations in these reactions, and the influence of various factors on these reactions are cited.

The composition of saliva is discussed in which the following are emphasized: the calcium, sulphocyanide, phosphorus, ferments, and hydrogen ion concentrations, changes in composition due to nervous, psychic, and drug influences, and the abnormal constituents of salivary secretions. A correlation is made between the compositions of saliva and of blood, and between changes in salivary secretion and variations in the constituents of the blood, as well as parathyroidectomy.

A brief commentary is made on findings concerning the possible bacteriocidal activity of saliva, as well as the possible relationships of salivary reactions to dental caries and diseases of the oral mucosa.

Tikhomirova, A. N., 1939. VLIYANIE IR (INFRAKRASNOGO) OBLUCHENIYA NA DEIATEL'NOST' ALIUNNYKH ZHELEZ SOBAKI The influence of IR (infrared) radiation of paratid gland activity in the dog. Fizioterapiia, 1939 (3): 40-44.

The effect of infrared radiation on parotid gland activity was studied in 58 experiments in two fistulated dogs. Salivary samples were collected during hourly 3-minute feedings of rusk powder over a 5 to 6-hour test period; tests were repeated after one to 3 days. Saliva, collected during the first hour of tests not preceded by radiation, was cloudy and viscid. Variation in the rate of flow during a test day were insignificant; the salivary lactic acid content varied little during a test day but ranged from 17 to 25 mg.% from day to day. The salivary sugar content gradually dropped from an initial 7 to 11 mg.% to one to 3 mg.% at the end of a day; salivary dry residue showed a similar drop from an initial 1.15 to 1.19 mg.% to a final 1.0 to 1.1 mg.%; a similar drop in the organic matter was noted.

Infrared radiation was administered over a 2-hour period to produce a 0.3-0.5°C. rise in body temperature, accompanied by an increase in pulse and respiration rates and by rising anxiety. Spontaneous salivation, which began 15 to 20 minutes after the start of radiation, disappeared with other symptoms 20 to 30 minutes after radiation ceased. Rusk-stimulated samples of saliva were collected as before, an hour after radiation. No change was noted in the amount of secretion during a test day, but a gradually increasing diminution was seen in the lactic acid content totaling a 20 to 30% drop; other salivary determinations showed no notable changes from the previously-established values. Prolonged

radiation of varying exposure periods over a 10-day span resulted in an increasing sensitization of the animal, loss of appetite, decrease in unconditioned salivation, and notable decreases in salivary lactic acid and sugar. No notable changes were seen in either the dry residue or the organic or inorganic content. The salivary sugar level gradually returned to normal 20 days after radiation was stopped. The amounts of lactic acid and sugar in HCl-stimulated saliva were considerably lower than those of rusk-stimulated saliva; radiation prior to HCl-stimulation produced no stable changes in these values.

Tilden, Evelyn B., and Muriel Svec, 1950. TYPES OF ACIDOGENIC LACTOBACILLI ISOLATED FROM SALIVA. Jour. dental Res., 29 (5): 659.

"A group of cultures of lactobacilli, most of them isolated from the salivas of orphanage children by the method of Davies, Slack, and Tilden (calcium phosphate plate) has been compared as to their (1) production of acid on glucose broth, (2) capacity to produce acid and gas on glucose agar (Snyder's medium), (3) action on milk, (4) action on carbohydrates, and finally, (5) their growth and acid production on a synthetic medium devised for microbiological assay of phenylalanine by means of *L. casei*. The proportion of strongly acidogenic cultures (final pH below 4.0 in glucose broth) was high, 74 per cent of the total, as would be expected from the method used. Eighteen lactobacilli of the gas-forming (heterofermentative) type were identified, 13 of these evidently being *L. fermenti*. Forty-five cultures were obtained which appear to be *L. casei*. The group of *L. casei* includes 7 cultures isolated from root canals in an earlier study. Sixteen strains were lactose-negative and have not yet been identified. The remaining 29 strains resembled *L. casei* in their acidogenic capacity and fermentation tests but failed to grow on the synthetic medium. None of the 101 cultures studied resembled *Lactobacillus acidophilus* as defined by Pederson or by Tittsler et al." (Complete paper.)

Timofeeva, T. A., 1945. ISKAZHENIE KHODA SLIUNOOTDELENIYA U NEKOTORYKH SOBAK (Distortion of the course of salivation in some dogs). Trudy Fiziol. Labor. I. P. Pavlova, 12 (2): 176-185.

A study of conditioned reflexes in three dogs revealed an abnormal curve of salivary secretion. The dogs belonged to the polar race with characteristically strong guardian reflexes; one of them was of a nervously very strong and balanced type. It is known that the normal curve of conditioned salivary reaction in dogs assumes an ascending course, i.e. upon registration of salivation every 5 sec. during isolated action of the conditioned stimulus (within 20 sec.) the conditioned secretion during each subsequent time interval (5 sec.) surpasses that of the preceding interval of equal duration.

In the above dogs, however, the amount of salivation during the first 5 sec. was very large, then decreased, to increase again toward the end of the delay. A marked orientation reaction invariably ensued at the commencement of action of the conditioned stimulus: the dog pricked up its ears as if mobilizing itself for activity. This reaction has been termed by I.P. Pavlov "mobilization reflex".

Tissenbaum, M. S., 1948. VLIĖANIE PROTEZOV NA KONTSENTRATSIIŨ VODORODNYKH IONOV SLIŨNY [The influence of prostheses on the hydrogen ion concentration in the saliva]. *Stomatologiya*, 2: 61-62.

The pH values of the saliva were measured in 86 dental patients of different ages before, during, and after the wearing of a prosthesis. 5-8 cc. of saliva was collected before breakfast during 10 to 12 min. and examined less than 3 h. later. The pH was determined by Michaelis' calorimetric comparator.

The results showed no influence of the prosthesis on the pH of saliva, even after prolonged wearing, the average pH before the prosthesis being 7.07, and after long wearing 7.17. Moreover, the reaction of the saliva remained normal, regardless of the presence or absence of a prosthesis or of the metal of which it was made.

The author does not consider these results to be exhaustive.

Titajew, A. A., and W. J. Unik, 1929. ÜBER DIE BEDEUTUNG DER ELEKTROLYTE DES BLUTES FÜR DIE SEKRETION DER GLANDULA SUBMAXILLARIS [The importance of electrolytes of the blood in the secretion of the submaxillary gland]. *Pflüger's Arch. ges. physiol.*, 223 (1-2):92-94.

The secretion of the submaxillary gland is regulated by the chorda tympani and by a branch of the carotid plexus of the sympathicus. Salivation of the isolated submaxillary gland was observed during electrical stimulation of either the chorda tympani, or the sympathicus, while the gland was alternately perfused with Ringer solution, the same containing no Ca, and in turn no K. Complete absence of Ca inhibited salivary secretion completely.

Another test was carried out on the non-isolated submaxillary gland. Ten cc. of sodium citrate was introduced into the blood of the dog at various intervals and the effect of the stimulation of the chorda on salivary secretion was measured. After a while both the Ca content of the blood, and the effect of the stimulation of the chorda decreased entirely. Following injection of CaCl_2 into the gland, the stimulation effect reappeared. It became evident that the secretory fibers of the chorda exercise their function by the calcium ions while the vasomotorial fibers would react through the potassium ions. It is interesting to mention that even the injection of a slight amount of sodium citrate inhibited salivation and the simultaneous stimulation of the chorda only emphasized this decrease.

Tomonaga, Tokuro, 1940. ÜBER DIE BEZIEHUNG ZWISCHEN DEM EISLERSCHEN HETEROGENETISCHEN MENSCHENBLUTANTIGEN UND SCHWEINEBLUTKÖRPERCHEN UND ÜBER DIE UNTERSCHIEDUNG VON AUSSCHIEDER- UND NICHTAUSSCHIEDER-TYPUS DES MENSCHLICHEN SPEICHEL DUCH DIE HEMMUNG DER HÄMOLYSE ODER AGGLUTINATION DER SCHWEINEBLUTKÖRPERCHEN [On the relationship between the Eisler heterogenetic human blood antigen and pig blood corpuscles and on the differentiation of secretory and non-secretor types of human saliva by inhibition of hemolysis or of agglutination of pig blood corpuscles]. *Jap. Jour. med. Sci.*, (7), 3 (3): 124*-127*.

A differentiation of secretor and non-secretor types of human saliva was possible by observing the effect of the saliva on hemolysis and agglutination of pig erythrocytes by immune sera.

Saliva of secretors inhibited these reactions, but that of non-secretors did not.

Tooper, E. B., and L. S. Fosdick, 1949. SOME AMINO ACID DERIVATIVES OF p-HYDROXYBENZOIC ACID. *Jour. dent. Res.*, 28 (6): 644.

Certain derivatives of p-hydroxybenzoic acid, designed to be retained by the mucin plaque, were tested as enzyme inhibitors. The acid was coupled to the amino acids, glycine, alanine, phenylalanine, aspartic acid, glutamic acid, methionine, and leucine for the tests. In the concentrations used, all the derivatives either showed no inhibiting properties or were very mild in their action. [From author's abstract]

Torrey, John C., and Marsha K. Reese, 1945. INITIAL AEROBIC FLORA OF NEW-BORN INFANTS. SELECTIVE TOLERANCE OF THE UPPER RESPIRATORY TRACT BACTERIA. *Amer. Jour. Diseases Children* 69 (4): 208-214.

A quantitative study of the bacterial flora of the nose, nasopharynx and throat of 105 newborn, full-term infants was made at various times after birth. In 29 infants studied within 6 hours after birth, 26 (89.6%) of the throat cultures and 26 (89.6%) of the nose and nasopharyngeal cultures were sterile; in 19-34 hours, none of 17 cultures taken from the same region were sterile. The *Staphylococcus albus* [*Micrococcus pyogenes* var. *albus*] count rose from 10.3% at the 0-6 hour period, to 76.5% in the 19-24 hour period; diptheroids, from 3.4% to 17.5%; streptococcus (α or γ), from 6.0% to 76.5%. Three percent growths of *Streptococcus* (mucoid colonies) and *Staphylococcus aureus* occurred in cultures made at 7-12 hours, and increased to 17.6% and 29.4%, respectively, at 19-24 hours. A 3% growth of *Escherichia coli*, appearing within 7-12 hours, had disappeared within 24 hours.

The occurrence of non-hemolytic streptococci and hemolytic staphylococci in the nose, nasopharynx, and throat of 105 infants was studied during their first week of life. On the first day, 18% of the nasopharyngeal and 35.2% of the throat cultures were positive for streptococcus (α or γ); at 4-8 days, 28.6% of the nasopharyngeal cultures and 100% of the throat cultures of 63 infants were positive. When tested for the presence of *Staphylococcus aureus* (hemolytic) on the first day, 6.6% of the nasopharyngeal cultures and 4.8% of the throat cultures were positive; at 4-8 days of age, 88.8% and 55.5% respectively, were positive.

The relationship between the oral floras of 70 mothers and of 70 infants was studied during the first week of life. In general, observations indicated that the upper respiratory tract of infants rarely becomes infected with pathogens during the first two weeks of life, although the nursing mother may be a carrier.

The mucous membrane of the new-born infants appeared unreceptive to pathogenic microbes as well as to some non-pathogens; although pneumococci occasionally occurred in cultures taken within a few days of birth, they disappeared from the secretions soon thereafter. A similar phenomenon was observed on other bacterial pathogens (i. e. *Streptococcus salivarius*, the gram-negative diplococci, and the hemoglobinophilic *H. haemolyticus* [probably *Hemophilus haemoglobinophilus*]). The author attributes this phenomenon to a "failure in biologic adaptation rather than to the action of immune globulin of maternal origin".

Tournade, A., and J. Malméjac, 1939. CONTRIBUTION À L'ÉTUDE DE LA SÉCRÉTION SALIVAIRE PAR LA MÉTHODE DE LA GLANDE SOUS-MAXILLAIRE "IRRIGUÉE" [Contribution to the study of salivary secretion using the "irrigated" submaxillary gland method]. Compt. rend. Soc. Biol. (Paris), 104: 178-180.

Stimulus applied to the sciatic nerve in a dog, whose right submaxillary gland is being perfused by blood of a second dog, produces active secretion in both salivary glands. Gradual injection of 5 to 10 mg. of pilocarpine into the saphenous vein of the experimental animal stimulates abundant, prolonged secretion by the left submaxillary gland only, indicating the sialogogue effect of pilocarpine to be exclusively peripheral to the neuroglandular apparatus. After establishment of this salivation the administration of 10 mg. of atropine, in a series of 1 to 2 mg. intravenous injections, causes the salivation to abate and finally stop, showing the substance to paralyze the peripheral nerves. Pyridine and Coramine, like nicotine, act on the salivary nerve centers to stimulate activity of the irrigated, or perfused salivary gland.

Tournade, A., and Ed. Joltrain, 1936. ACTION DE L'ÉVIPAN SODIQUE SUR CERTAINES FONCTIONS DE L'APPAREIL DIGESTIF (SÉCRÉTION SALIVAIRE ET PANCRÉATIQUE, MOTRICITÉ INTESTINALE) [The action of evipan on certain functions of the digestive system (salivary and pancreatic secretion, intestinal motility)]. Compt. rend. Soc. Biol. (Paris), 121: 908-909.

Reflex salivation is temporarily reduced or abolished, depending on the dose, under the influence of evipan. Stimulus to the sciatic nerve produces little or no submaxillary saliva, whereas excitation of the chorda still elicits a definite flow of saliva which is usually less abundant than that stimulated before injection of evipan. The substance is considered to affect the whole neuroglandular system but centrally more than at the periphery.

Toverud, K. U., and G. Toverud, 1934. FORTSATTE UNDERSKELSER OVER MINERALSTOFFSKIFTET. IV. VIRKNINGEN AV MINERALPREPARET "KALFOSITT" [Continued investigations on changes in mineral content. IV. Effects of a mineral preparation, "kalfositt"]. Norsk Mag. f. Laegevidensk., 95 (10): 1180-1189. In Norwegian, with English summary, p. 1189.

In studying the effect of "Kalfositt" (a mineral salt preparation) in the diet, the author cites the work of Signe Jonsgar (no reference given) who found that the abnormally low salivary calcium content in children on a low mineral diet could be corrected with a dietary supplement of Kalfositt.

Trancu-Rainer, M., 1931. ELIMINATION DES HORMONES SEXUELLES PAR LES GLANDES SALIVAIRES [Elimination of sexual hormones through the salivary glands]. Compt. rend. Soc. Biol. (Paris), 106: 1001-1002.

The presence of prehypophysial and estrogenic hormones in saliva of pregnant, aborted, parturient, and post parturient women was investigated. Immature rats and mice were inoculated, in 6 to 8 injections, with 1 to 8 ml. of etherized saliva from each of 12 women in one of the

above conditions, and the animals were sacrificed on the 4th to 6th day. The saliva of pregnant women produced maturation of the follicles and luteinization in the test animals; the salivas of one aborted, one parturient, and one pregnant woman also produced a mild hemorrhage; salivas of post parturient women produced no reaction in two cases. In one case of 6-months pregnancy, the hormone content of saliva was compared with that of urine. At a 1:10 dilution the saliva produced only a maturation of the follicles, while urine at the same dilution produced all three reactions (maturation of the follicles, luteinization, and hemorrhage). Positive results were obtained when castrated mice were injected with a total of 2.4 ml. of etherized saliva obtained from each of 3 cases of 2nd, 3rd, and 7th month pregnancies. From the results obtained in these experiments, it is concluded that estrogens first appear in saliva in the early stages of pregnancy, rather than in the later ones as stated by other investigators.

Trimble, Harry C., James W. Etherington, and Paul K. Losch, 1938. RATE OF SECRETION OF SALIVA AND INCIDENCE OF DENTAL CARIES. Jour. dental Res., 17 (4): 299.

Salivary flow after paraffin stimulation was studied in 107 dental students. The average secretion rate was 34 cc./15 min. (ranging from 9 to 68 cc.). A repetition of the study on 41 persons after two weeks showed that the quantity did not vary more than ± 5 cc. in 68% of the group. A larger group retested after 6 months yielded similar results.

The secretion rate was inversely proportional to the incidence of caries.

Triolo, Gaspar, 1897. AZIONE DELLA SALIVA SUI BATTERI. CONTRIBUTO ALLO STUDIO DEI MEZZI NATURALI DI DIFESA DELL'ORGANISMO CONTRO LE INFEZIONI [The action of saliva on bacteria. Contribution to the study of the natural means of defense of the organism against infections]. Ist d'Igiene della r. Univ. Palermo, Lav. di Lab., 3: 57-75.

Fresh, normal saliva was filtered and inoculated with Staphylococcus aureus. There was no inhibitory action of Staphylococcus. Filtered saliva, mixed with unfiltered (bacteria-containing) saliva, showed progressive growth of the bacterial colonies.

Unfiltered, bacteria-free saliva (obtained after disinfecting the mouth with 1% sublimate solution or with potassium permanganate solution, and repeated rinsing with distilled water) inhibited the growth of S. aureus, of airborne bacteria, diphtheria bacilli, Sarcine lutea, a "Similtifo", and Bacterium zopfii. 5-day cultures of typhoid bacilli and Staphylococcus aureus were inhibited; 18-hour cultures were only reduced in number.

There was no difference in inhibitory action between the secretion of the parotid glands and that of the submaxillary. Both were effective against 5-day cultures of Staphylococcus, but had only a bacteriostatic effect on other bacteria.

From the fact that mixed saliva has a more pronounced antibacterial action than the secretions of the parotid and submaxillary glands, the author concludes that the mucous glands of the oral cavity contribute to the effectiveness of the saliva. The importance of the antibacterial effect of the saliva is best understood if

we consider that bacteria enter the mouth cavity continuously in great numbers through the air breathed.

Troitskii, I. A., 1936. MEKHAZIM SEKRETOR-NOI DEĬATEL'NOSTI OKOLUSHNOI ZHELEZY U LOSHADI [The mechanism of secretory function of the parotid gland in the horse]. Fiziol. Zhur. SSSR, 20 (3): 428-434.

Study of parotid gland secretion in a fistulated horse showed the sight of food for a 10-minute period to evoke food motor-reflexes and general excitement but no saliva flow. Unconditioned parotid salivary responses to 1 kg. amounts of hay, oats or bran in 50 gm. portions, showed the presence of a periodic bilateral alternation of high and low rates of secretion, with duration of period and rate of flow largely dependent on nature of the food. Higher flow rates and decreased low-secretion periods were found associated with increase in food bulk. Feedings of hay elicited 2775 cc. of saliva during the 1-hour period of rapid secretion and 820 cc. during the 3-hour period of low secretion. Oats elicited 1470 cc. during a 2 to 2.5-hour period of rapid secretion and 47 cc. during the diminished secretion period of similar duration; bran feedings elicited 940 cc. and 30 cc. respectively, during the high and low flow periods of like duration. Latency showed similar alternation, varying from 10 to 20 seconds up to 1 minute in duration during the period of increased secretion. Administration of water elicited no saliva but did affect salivation in response to foods. Substitution of food stimuli during an experiment did not affect the phase of secretion already induced by a food; forced change of mastication from one side of the mouth to the opposite by painful irritation produced a corresponding change in phase of secretion. Salivary flow, lacking alternation of high and low secretion rates, was elicited by sand, pepper, or solutions of hydrochloric acid or sodium hydroxide, placed on the base of the tongue. The experimental data indicates parotid salivary flow in the horse to be induced by stimulation of the lingual mucosa. The increased stimulation on the side of mastication is attributed to the position of the taste papillae which are located laterally and at the base of the equine tongue. Feeding of small food portions increased the speed of formation of the food bolus on the side of mastication and accentuated the apparent relationship between mastication and ipsilateral increase in parotid secretion. Latency on the side of mastication was approximately one half that of the opposite side.

Troitskii, I. A., 1937. USLOVNOREFLEKTORNOE SLĬUNOOTDELENIE NA VID I ZAPAKH PISHCHII U LOSH-ADEI IZ OKOLOUSHNOI ZHELEZY [Conditioned reflex parotid secretion at the sight and smell of food in horses]. Fiziol. Zhur. SSSR, 23 (2): 343-346.

Further study was made on conditioned salivary secretion in a 7-year old horse with fistulated Stensen's duct. The secretion was studied during 3 months and its amount, specific weight, viscosity and dry residue determined.

During 4 months no conditioned salivation could be observed, which corresponds to previous observations made in 3 horses (Troitskii, 1936). Tests were then started to work out a conditioned

salivary reflex in response to teasing with food (during 3 min.), supported by subsequent feeding. A salivary response to this stimulation rapidly appeared. The secretion varied greatly in amount, depending on the stimulated condition of the gland and the nature of the stimulant. It was found to correspond, proportionally, to the amount and general flow of the unconditioned secretion elicited by the same food: it was greater for hay than for oats.

Qualitatively, the conditioned saliva has a higher specific weight, an increased viscosity, and a greater amount of dry residue than the unconditioned. While the amount of unconditioned parotid saliva elicited by 1 kg. of hay is up to 2500 cc. (up to 50 l. per day), is watery with an insignificant dry residue content, the amount of conditioned parotid saliva is sharply reduced, which increases the salivary concentration accordingly.

As these results contradict other authors (Mulikov, 1933; Gottschalk, 1910; Ellenberger and Sheinert, 1933) and his own earlier findings (Troitskii, 1933), the author explains them partly by the great stimulation capacity of the present animal, and partly by the method adopted.

Tsuprova, N. D., 1950. GLIKOLITICHESKAĬA SILA SMESHANNOI SLĬUNY U LIUDEI, RESISTENTNYKH I PREDRASPOLOZHENNYKH K KARIESU [The glycolytic power of mixed saliva in individuals resistant or predisposed to dental caries]. Stomatologiya, 2:12-14.

Study was made of the acid-forming capacity of saliva. The spontaneous saliva was collected 1 h. after breakfast and its pH determined by the electrometric procedure; the secretion was then stimulated through chewing of wax. To one 2 cc. sample of saliva 0.5 cc. of a 1% glucose solution was added, another sample serving as control. The pH was measured in both tubes which were then placed at 37°C. The pH was again measured 2, 4, 6 and 24 h. later. The saliva of 87 caries-resistant or affected people was examined 3 or 4 times.

It was observed that in mixed spontaneous saliva the pH is slightly higher in people resistant to caries (average 7.3) than in the non-resistant (average 6.9). In the saliva stimulated by chewing of wax the pH was always considerably higher (average difference 1 unit) than in the spontaneous saliva of both categories of people.

The saliva to which glucose is added increases progressively in acidity, while the control saliva increases in alkalinity.

In comparing the results for both groups of people after addition of glucose, a sharp difference in the curves of acidification was noticed: in the saliva of caries-resistant people the pH drops 3 in 24 h. from 8.2 to 6.4 (1.8 units); in cases of multiple caries, it drops from 7.9 to 4.96 (2.84 units), i.e. the drop in pH proceeds more rapidly. The greatest drop takes place during the first 6 h., then slows down, and may even rise, occasionally, especially in saliva of caries-resistant people. In both groups of people the results were very uniform.

The author concludes that the changes of pH in saliva are so regular that they can serve to indicate the resistance to caries. The

divergencies observed are due either to the difference in the intensity of glucose fermentation, or to the difference in the buffer capacity of the saliva.

Tullar, Paul E., 1953. ACID FORMATION IN HUMAN SALIVA. Jour. dent. Res., 32 (5): 688.

Measurements of pH were made over a 6-hour period of saliva (from caries-rich and from caries-poor individuals) exposed to various conditions of temperature, mixing, centrifugation, and dextrose concentrations.

Non-sugared, control, samples of saliva showed a gradual increase in pH and in odor characteristic of proteolysis. Saliva containing 10% dextrose showed a drop in pH to 3.8 in 30 to 60 minutes. Removal of solid matter from saliva by centrifugation stopped acid formation in the saliva; addition of the centrifugate to 10% dextrose solutions caused a rapid acidification of the solution similar to that observed in saliva-dextrose solutions. It is concluded that acidogenic enzymes, present in the suspended matter of saliva, are capable of rapid acid production in the presence of sufficient sugar. Saliva is either not the good buffer it is considered to be, or the acid-producing power of sugar in saliva is greater than previously thought.

Tullar, Paul E., 1956. RAPID ACID FORMATION RESULTING FROM THE ACTION OF PLAQUE OR SALIVARY SEDIMENT ON SUGAR. Jour. Dental Res., 35 (2): 220-225.

Samples of fresh dental plaque or salivary sediment, obtained from 40 young adult males, were combined with sugar in the presence of methyl red indicator and incubated at room temperature. Results showed production of acidic concentrations of pH 4.3 or less and capable of demineralizing dental enamel to be formed in from 8 to 281 seconds at test temperatures.

Tunncliffe, Ruth, 1940. ACTION OF GASTRIC AND SALIVARY MUCIN ON PHAGOCYTOSIS. Jour. infect. Diseases, 66 (2): 189-191.

Twenty g. of gastric mucin were dissolved in 100 cc. of water, autoclaved, allowed to settle and the supernatant fluid was used. Human saliva was collected and acidified with 4% lactic acid to precipitate the mucin. The mucin was then washed with water, alcohol, and ether, dried and used as 1 part to 20 parts of saline solution.

To see if mucin would coat Staphylococcus albus [Micrococcus pyogenes var. albus] and Streptococcus viridans [G. mitis] and prevent the entrance of other materials, the organisms were suspended in mucin, dried, and stained with a capsular stain. No artificial capsule could be demonstrated. However, when these 2 organisms, and also a lactobacillus and a pneumococcus [Diplococcus pneumoniae] were similarly treated and then stained with a vital stain, the organisms would not take up the stain. When bacteria thus treated were mixed with salt solution, saliva, ropy saliva, or egg white, they stained instantaneously.

Equal parts of citrated blood, bacterial suspension (24-hour broth cultures of streptococci or staphylococci), and either physiological saline solution or a mucin solution were mixed in capillary pipettes, incubated 25 minutes, smeared on microscopic slides, dried and stained

with Wright stain. The number of cocci per leukocyte in 50 polymorphonuclear leukocytes and the number of cells taking part in phagocytosis were noted. These experiments were done with both salivary and gastric mucin.

In 5 experiments there was no phagocytosis of mucin-coated staphylococci, whereas the saline solution and staphylococci mixture showed 8% to 16% of the cells taking part in phagocytosis. In two other experiments there was slight phagocytosis in the mucin preparation, but there was 3 to 5 times as much activity in the parallel preparations with saline. Phagocytosis of streptococci was also diminished by mucin.

Fourteen mice were injected intraperitoneally with 1 cc. of 24-hour broth culture of staphylococci in equal parts of either saline solution or gastric mucin. Peritoneal fluid was examined microscopically at 1 hour and at 5 hours after injection, to observe phagocytosis.

The experiment showed that mucin-coated staphylococci were not taken up by leukocytes for 2 hours following injection, after which time they multiplied enormously and killed the mice in 24 hours. Phagocytosis occurred at the end of 1 hour with the saline and staphylococcus mixtures and the mice recovered. Vital staining of the peritoneal material (mucin-treated staphylococci) showed unstained (mucin-coated) cocci as long as 3 hours after injection. Only the cocci not coated with mucin were taken up by the polymorphonuclear leukocytes.

Turesky, S., B. G. Bibby, and Irene MacKinnon, 1943. THE EFFECTS OF VARIOUS FACTORS ON THE ELIMINATION FROM THE MOUTH OF ARTIFICIALLY INOCULATED YEAST. Jour. dental Res., 22 (3): 227.

"Tests on the elimination of artificially introduced yeast from the mouth confirmed the findings reported by Knighton. In descending order, chewing apples, sticky candy, chewing gum, paraffin and peach were more effective than toothbrushing in cleaning the mouth. The rate of salivary flow and other intrinsic factors seemed to be of more importance in determining the rate of removal of yeast than the nature of the cleansing agents used on a toothbrush." (Complete paper.)

Turesky, Samuel S., and Basil G. Bibby, 1944. SOME OBSERVATIONS ON THE ELIMINATION OF YEAST FROM THE MOUTH. Jour. dental Res., 23 (1): 51-57.

The effectiveness of various cleansing procedures on the elimination of yeast from the mouth was studied. Effectiveness was measured by determining the number of yeast cells found in the mouth after eating a yeast cake and cleansing the mouth. Yeast counts were made by having the subject chew a piece of paraffin, collecting the stimulated saliva, and then making a yeast count by plating 0.1 cc. of suitable dilutions of saliva on Sabouraud's agar and incubating for 48 hours.

"Tests on the elimination from the mouth of artificially introduced yeast indicate that, in descending order, chewing apples, sticky candy, chewing gum, paraffin and peach were more effective than toothbrushing in cleaning the mouth.

"Preliminary tests indicate that carrot and bread and butter greatly aided but that prior use of mineral oil interfered with the cleansing mechanisms of the mouth. Intrinsic factors possibly including the rate of salivary flow seemed

to be of more importance in determining the rate of removal of yeast than the nature of the cleansing agents used on a toothbrush." (Authors' summary.)

Turkheim, H. J., 1952. THE EFFECT OF TOBACCO SMOKE UPON SOME BACTERIA. Jour. dent. Res., 31 (3): 326-328.

In vitro studies showed bacteriostatic and bactericidal effects of tobacco smoke on certain strains of bacteria incubated on agar slants. In further tests *P. pyocyanea* [*Pseudomonas aeruginosa*], *Chrom. prodigiosum* [*Serratia marcescens*], *B[acillus] subtilis*, *E[scherichia] coli*, *Staph. aureus* [*Micrococcus pyogenes* var. *a.*], *L[actobacillus] acidophilus odontolyticus*, and saliva were incubated on plain agar or agar mixed with a filtered, oral saline-rinse obtained before as well as after smoking a cigar. No growth differences were noted; two species did show pigmentation differences. *P. pyocyanea* and *Chrom. prodigiosum* formed little pigment on plain agar; on saliva agar *P. pyocyanea* appeared slightly pink and *Chrom. prodigiosum* typically red, while under filtered u-v light colonies of the former were yellow-green and fluorescent, those of the latter were brown-red with a gray circumference. On tobacco-saliva agar *P. pyocyanea* colonies were very strongly yellow and fluorescent; those of *Chrom. prodigiosum* were brilliant purple with a dark gray circumference.

Turner, Clair E., M. W. Jennison, and H. E. Edgerton, 1941. PUBLIC HEALTH APPLICATIONS OF HIGH-SPEED PHOTOGRAPHY. Amer. Jour. Public Health, 31 (4): 319-324.

High speed (1:30,000 sec.) photography of sneezing shows violent, unstifled sneezes to expell thousands of droplets, usually less than 2mm. in diameter, and largely from the saliva in the front of the mouth. The number of droplets issuing from the nose is insignificant. These studies show that the handkerchief or hand held over the mouth are highly effective in preventing expulsion of droplets. Droplet velocities up to 152 ft./sec. in violent sneezes have been recorded although slower speeds are more common. The majority of droplets have been found to travel 2 to 3 feet; larger masses may be expelled 12 feet or more.

Turner, Naomi C., and E. M. Crane, 1944. A RELATIONSHIP BETWEEN DENTAL CARIES AND SALIVA. Science, 99 (2570): 262. Also in Jour. dent. Res., 23 (6): 413-416.

A study of 51 cases revealed that there is an inverse relation between the amount of dental caries of an individual and his salivary rate of starch hydrolysis.

Turner, Naomi C., and Edward M. Crane, 1944. A RELATIONSHIP BETWEEN DENTAL CARIES AND SALIVA. Jour. dental Res., 23 (6): 413-416.

A relationship between the rate of starch hydrolysis produced by saliva and the incidence of caries was observed in a study of 51 individuals (5 to 20 years old), 4 of whom were free of caries.

The hydrolysis of starch was indicated by the spot-test disappearance of starch-iodine blue. Saliva was collected 2 hours after eating and tested 1 to 3 minutes after collection.

At room temperature (23°C.) 1 cc. of saliva was mixed with 1 cc. of 1% starch solution and a stop watch was started. On a spot plate 4 drops of the saliva-starch mixture was stirred with 1 drop of potassium triiodide solution (5 g. I₂, 10 g. KI, 80 cc. water) at the following intervals: 30 seconds, 1, 1-1/2, and 2 minutes. After 2 minutes, 1-minute intervals were used for the next 10 minutes, then 5-minute intervals were used until there was an indication that the end point was near, at which time 1-minute intervals were resumed. The disappearance of the blue-purple color was called the end point. The spot appeared brown.

Saliva associated with severe caries hydrolyzed the starch with great rapidity; while individuals without caries produced saliva which hydrolyzed the starch very slowly. (cf. Turner et al., 1940).

Turner, Naomi C., 1945. TRYPTOPHANE AS A PREVENTIVE FOR CARIES. Jour. School Health, 15 (3): 53-57.

The in vitro ability of various amino acids to increase or decrease the salivary hydrolysis of starch was studied. Results showed that l-glutamic acid, l-histidine HCl, glycerine, and l-lysine monohydrochloride slightly decreased the hydrolysis rate; l-tyrosine and l-proline were comparable to aqueous blanks; l-leucine, l-methionine, l-alanine, and l-cystine increased the hydrolysis time; tryptophane decreased the hydrolytic rate to a degree similar to that of saliva occurring with caries-free teeth. The effects of indole and pyrrole (tryptophane derivatives) closely approximated those of tryptophane.

Saliva secured after the oral cavity had been rinsed with tryptophane solution showed a decrease in hydrolytic activity; the ingested tryptophane apparently affected the salivary amylase to such a degree as to weaken its ability to hydrolyze starch.

Turner, Naomi C., and George E. Crowell, 1947. DENTAL CARIES AND TRYPTOPHANE DEFICIENCY. Jour. dent. Res., 26 (2): 99-104.

Further study of the relationship between susceptibility and a salivary enzyme factor (Turner, N., 1944) shows a correlation between degree of dental decay and a lack of tryptophane or similar indole-containing molecule. Tests of salivas of 7 caries free subjects showed a positive purple-ring reaction in glyoxylic acid (pH 4.5 - 6.5) and concentrated H₂SO₄; the salivas of 16, from a group of 17 persons with active, rampant caries, showed only a near negative or trace reaction.

Comparison of the time required by saliva to decolorize preformed starch blue (pH 6.8, redox + 322 mv) showed samples from the caries-free group to require an average of 4.8 minutes, and for caries-active salivary samples, 13 minutes.

Test of whole specimens of saliva from the two groups showed the average initial redox potentials of saliva from the carious group to be + 309 mv. and from the caries-free group, + 307.9 mv.; the average 10-minute redox poise drop for the carious group was 261.9 mg, and for the caries-free group, 212.1 mv. The average 30-minute redox poise drop was more rapid in the carious group, 570.3 mv., as compared to 346.3 mv. for the caries-free.

Ingestion of d-l tryptophane in crystal powder-form midway between breakfast and lunch, by a group of young adults on 4 successive days, showed the starch blue reduction time to drop from an average of 15 minutes to 6 minutes. The average 10-minute redox poise drop before ingestion of the tryptophane was 132 mv.; after ingestion it was 111 mv. A notable parallel was found in 5 subjects of this group between amounts of tryptophane in saliva and in blood serum, whether this substance occurred naturally or followed ingestion. Correlation was confirmed between active caries and rapid amylolytic time: 13 minutes for saliva from caries-active mouths, and 69.7 minutes for saliva from caries-free. The effect of tryptophane on starch breakdown and calcium precipitation is discussed. It is suggested that presence or absence of dental caries may be associated with the presence of α and β amylase in varying amounts in the saliva.

Turner, Naomi C., and George E. Crowell 1947. TRYPTOPHANE IN CARBOHYDRATE METABOLISM. *Jour. dent. Res.*, 26 (5): 359-363.

Ingestion of small amounts of tryptophane over a 3-month period by 4 of 8 young adults, showing rampant dental caries, was followed by a drop in acid production by their salivas over a 2-hour period when incubated at room temperature with a 1% starch solution. An increase in the amount of salivary reducing substance was also noted. The presence of tyrosine in the saliva, detected by microscopic examination, was confirmed by chemical (Millon's) test.

Turner, Naomi C., and George E. Crowell, 1952. EFFECT OF TEMPERATURE UPON THE DEXTRINIZATION OF STARCH BY SALIVARY ENZYMES. *Jour. dental Res.*, 31 (3): 359-360.

The effect of temperature on the dextrinizing activity of pooled human saliva was studied *in vitro*. The time involved varied indirectly with the temperature: the same amount of dextrinization which took place in 200 minutes at 50°F., was obtained in 6 minutes at 90°F.

Turner, Naomi C., J. H. Scribner, and J. T. Bell, 1953. TITRATABLE ACIDITY, TITRATABLE ALKALINITY, AND pH OF THE SALIVA FOR 315 CHILDREN AGED 5 TO 11 YEARS. *Jour. dent. Res.*, 32 (5): 688-689.

A study was made of the saliva of 315 children, aged 5 to 11 years. Titratable acidities ranged from 0.4 to 10.4 with a mean of 3.01 ± 1.4 ; titratable alkalinities ranged from 4.9 to 21.2 with a mean of 10 ± 2.7 ; pH range was 6.4 to 8 with a mean of 7.32 ± 0.46 . It is suggested that low acidity and high alkalinity of the saliva are associated with caries-free individuals, while high acidity and low alkalinity of the saliva are associated with a high caries incidence.

Turner, Naomi C., J. H. Scribner, and J. T. Bell, 1954. THE RELATIONSHIP OF TITRATABLE ACIDITY, TITRATABLE ALKALINITY, AND pH TO THE INCIDENCE OF DENTAL CARIES. *Jour. Dental Res.*, 33 (1): 55-61.

Tests were made of the titratable acidity and alkalinity, and of the pH of samples of unstimulated mixed saliva from 315 children, aged 5 to 11, chosen at random from a school population appearing at the Forsyth Dental Infirmary,

Boston. Salivary acidity was measured against 0.001 N NaCl with a phenolphthalein indicator, alkalinity against 0.001 N HCl with a methyl red indicator; the pH was determined with a Beckman potentiometer.

Tabulated data for frequency distribution of titratable acidity for the group show a mean of 3.01 ± 1.4 ; variance 0.239; mode 2.7; and range, 0.4-10.4. Similar data for titratable alkalinity shows a mean of 10 ± 2.7 ; variance, 1.002; mode, 9.9; and range, 4.9-21.2. The mean for pH was 7.32 ± 0.46 ; variance, 0.17; mode, 7.3; and range, 6.4-8. A study of these chemical factors in relation to dental caries indicates that the relation of reserve basic or alkaline materials in the saliva to dental caries is closer and more consistent than is either titratable acidity or pH. It is suggested that the saliva of persons free from dental caries has either a high potentially basic conjugate or an enzyme system capable of yielding this result.

Turner, Naomi C., Menard M. Gertler, and Stanley M. Garn, 1954. DIFFERENCES IN THE RATE OF REDUCTION-OXIDATION POTENTIALS IN SALIVARY SAMPLES OF CERTAIN GROUPS OF INDIVIDUALS. *Science (New York)*, 119 (3102): 847-849.

The salivary redox pattern of a group of mentally defective individuals was found to differ from normal and heart-disease groups previously studied. Intensities of electron transfer in saliva elicited without mechanical or chemical stimulation, showed a general downward trend from a starting potential mean of approximately +280 mv. to +11 mv. over a 30 minute period. Both the normal group, with a drop to -132 mv. and the heart-disease group with a drop to -246 mv. systematically showed a quicker and a greater negativity. The difference in pattern was determined to be attributable neither to the bacterial content of the saliva nor to the age of the subjects.

It is suggested that the gross differences noted should not be attributed to any single system. Saliva contains I^- , CNS^- , glutathione, and possibly oxidation-reduction enzymes.

Turner, Naomi C., and J. T. Anders, 1956. DIMETHYLAMINO BENZALDEHYDE AS A MEASURE FOR SALIVARY "TRYPTOPHANE". *Jour. dental Res.*, 35 (2): 241-244.

An attempt was made to differentiate indole, indole-3-acetic acid, indole-3-propionic acid, tryptamine, and tryptophane in saliva to which each had been added. Results show that the dimethylaminobenzaldehyde method (Stack, 1954) does not provide an adequate means for differential identification of tryptophane.

Turner, Naomi C., and J. T. Anders, 1956. TITRATABLE ACIDITY AND TITRATABLE ALKALINITY OF THE SALIVA OF CASES CHOSEN WITH REFERENCE TO DENTAL CARIES. *Jour. dent. Res.*, 35 (3): 385-390.

In an extension of previous studies (Turner, 1954), titratable acidity and titratable alkalinity of the resting saliva are reported for a series of 213 children, including caries-free cases as well as cases showing variable degrees of dental caries. Acid titration made use of methyl red indicator; alkaline titration, of phenolphthalein. End points for a second series of 200 ± 2 children, including caries-free, and extensive, active, rapid dental caries, were

determined with a Beckman pH meter. The acidity values for the two series are quite similar and are comparable to the random sampling distribution of the 315 cases previously reported. The two series show greater tendency to multiple peaks with regard to alkalinity than does the frequency distribution for the random sample. "T" tests applied to the titration values for the caries-free and for the caries-extensive groups suggest that the buffer capacity rather than the acidity of resting saliva is more closely associated with dental decay.

Turner, N. C., J. T. Anders, and N. Becker, 1957. THIAMINE Cl-HCl EFFECT UPON ACID PRODUCTION AND UPON DEXTRINIZING TIME OF SALIVARY AMYLASE WITH CORN STARCH SUBSTRATE. *Jour. dent. Res.*, 36 (3): 343-348.

A mixture of one ml. of whole unstimulated saliva, incubated at 37°C with one ml. of 1% nonsoluble corn starch, was periodically tested for completion of amylolysis by treating a drop of the mixture on filter paper (previously impregnated with 1% potassium iodide) with 3% H_2O_2 . Absence of blue or lavender color under white fluorescent light indicated completion of the reaction. The test applied to unstimulated salivary samples from 135 children, generally aged from 4 to 12 years, showed saliva of 27 caries-free subjects to effect dextrinization in a mean time of 36.41 minutes, and in 21.33 minutes if 0.5 ml. of 1% B_1 (thiamine Cl-HCl) were added to the test mixture; samples from 94 subjects showing moderate dental caries required a mean time of 29.70 and 18.75 minutes for dextrinization respectively with and without vitamin B_1 added; salivary samples from 14 subjects with extensive caries required 20.86 and 15.86 minutes, without and with addition of vitamin B_1 respectively, for completion of amylolysis. The addition of vitamin B_1 shortened dextrinizing time in 131 of the 135 cases; the increased enzyme activity was significantly greater in salivary samples from the caries-resistant group than from subjects with recent rapid dental decay. The titratable acidity of saliva-corn starch mixtures after 2 hours of incubation was higher in tests using salivary samples from the extensive caries group than from the caries-free group, addition of vitamin B_1 to the saliva-starch mixtures increased the titratable acidity in all groups.

Turygina, A. V., 1955. VLIĖNIE BROMA NA SUMMATSII VOZBUZHDENII V SLIUNNOI PODCHELIUSTNOI ZHELEZE [The influence of bromine on summation of stimulation in the submaxillary gland]. *Biull. eksper. Biol. Med.*, Moskva, 40 (12): 3-5.

Fifteen experiments were conducted in the cat to investigate the minimal number of subliminal faradic strokes required to elicit submaxillary salivation before and at 10-minute intervals after intravenous injection of 0.025 gm./kg. weight of 1% sodium bromide. The minimal number of faradic strokes necessary to elicit salivary secretion at various stimulation frequencies of the chords was determined several times prior to each experiment; power of the faradic current was held constant during the entire study. Results showed that the experimental dose of sodium bromide altered the pre-injection response of the submaxillary gland to the summation of subliminal

stimulations, changing the number of strokes required to elicit saliva. When the pre-injection summation capacity was low or decreasing the injection increased the depression. When the pre-injection capacity was stable, the bromide injection produced variable results.

Turygina, A. V., 1955. O SUMMATSII VOZBUZHDENII V SKRYTOM PERIODE SEKRETSII SLIUNNOI PODCHELIUSTNOI ZHELEZY [On the summation of stimulation in the lag period of secretion of the submaxillary gland]. *Fiziol. Zhur. SSSR*, 5: 647-652. *Abst.*: *Sovet. med. refer. Obozrenie*, 1956 (28): 12.

A study was made of the submaxillary secretion of dogs and cats under short-termed experimental urethane narcosis. A single faradic shock applied to the peripheral end of the chorda tympani, by a "break" of the faradic current, was found to be incapable of producing submaxillary secretory response. Secretion appeared, however, following the summation of several "break" stimuli applied at intervals up to 6 to 9 seconds; this minimum number of "break" impulses capable of eliciting salivation did not vary during a 4 to 6 hour period under the same experimental conditions. A definite relationship was noted between the minimum number of impulses and the stimulation rhythm such that, with a 0.5 to 1.0 second stimulation interval, a minimal number of faradic stimuli were necessary to elicit submaxillary salivation.

The data secured from this experiment correspond to the results obtained by I. M. Sechenov in his study of the phenomena of summation of subliminal stimulations in the central nervous system.

Twort, C. C., and A. H. Baker, 1940. EFFECT OF SMOKE ON BACTERIA IN THE AIR. *Lancet* (London), 239 (6115): 587-589.

The effect of smokes of various origins on air-borne salivary organisms was studied; method is described in detail. When compared with tests on the "F" coccus (a saprophytic, white, Gram-positive micrococcus used as a standard test organism), the salivary microbes showed very little resistance to the smokes; a minimum concentration of smoke to affect the salivary flora was 1/10 that needed to affect the "F" coccus.

Results were calculated by taking the mean percentage of survivors over the whole period of the experiment (30 min.) and reducing the results to a standard based on a smoke concentration of 1 g. in 10 cubic meters of air. From this, the following survival rates (percentages) were calculated: cardboard smoke (high concentration) permitted a survival of 0.2% of the salivary organisms; cardboard smoke (medium concentration), 0.6%; cardboard smoke (low concentration), 0.5%; smoked cigarette, 0.7%; and smoldering cigarette 3.3%; cigar leaf, 4.1%; yang, 0.1% and incense in high concentrations 0.3%, in medium concentrations 0.5%, and in low concentrations 0.4%, and toluol-soluble incense, 0.2%.

Aerial smokes (cardboard and incense) in concentrations less than 1 g. in 30 m^3 air greatly reduced the infectivity of air-borne suspensions of "*S. enteritidis* (Liverpool virus)" for mice.

Ulicny, Harry P., 1936. SOME COMPARATIVE STUDIES OF LACTOBACILLUS ACIDOPHILUS ASSOCIATED WITH DENTAL CARIES. *Jour. dent. Res.*, 15 (6): 397-402.

The possibility of differentiating oral and intestinal lactobacilli by means of biochemical reactions was studied. Saliva and scrapings from dental cavities yielded almost pure cultures of lactobacilli and these were studied in comparison with known strains of *Lactobacillus acidophilus* of intestinal origin. A quantitative study of the utilization of lactose indicated that the oral and intestinal lactobacilli differed markedly in their ability to utilize it. The oral lactobacilli used the greatest amounts of lactose and showed closer inter-relationships among members of their group. Acetylmethylcarbinol production was too variable to differentiate oral and intestinal strains. Attempts to produce a bacteriophage from sewage filtrate and from pooled samples of saliva from 10 individuals against oral lactobacilli were unsuccessful.

Umeno, M., 1931. VI. UBER DAS VORKOMMEN DER PHOSPHATASE IN DER GALLE UND IM PANKREASSAFT [Studies on phosphatase. VI. On the occurrence of phosphatase in bile and in pancreatic juice]. *Biochem. Zeitschr.*, 231 (4-6): 346-351.

The phosphatase content of various organic tissues of the dog was determined. Tissue of the spleen, liver, pancreas, salivary gland and mucosa of the stomach, duodenum and small intestines was crushed and then dried at room temperature. The extract then was mixed with 0.89% sodium chloride solution and 1% toluol. In the experiment the phosphoric acid was precipitated with 5 cc. ammonia-magnesia mixture and was measured as magnesium pyrophosphate. Results indicated that phosphatase was present in the salivary gland; no phosphatase could be detected in the saliva.

Ungar, G., and J. L. Parrot, 1936. SUR LA PRÉSENCE DE LA CALLICREÏNE DANS LA SALIVE, ET LA POSSIBILITÉ DE SON INTERVENTION DANS LA TRANSMISSION CHIMIQUE DE L'INFLUX NERVEUX. [On the presence of callicrein in saliva, and the possibility of its intervention in chemical transmission of nervous influx]. *Compt. rend. Soc. Biol. (Paris)*, 122: 1052-1054.

Saliva, obtained by excitation of the peripheral extremity of the lingual nerve in the dog, produced a slight hypertensive effect followed by a pronounced hypotensive effect on arterial pressure when injected intravenously into the same animal. Such saliva lost the hypotensive effect when subjected to alcohol extraction or when in contact with blood at room temperature for one half hour. The hypotensor effect was increased in the animal by prior injection of cocaine. As callicrein paralleled these reactions, except for the initial hypertension, it is postulated that the active substance in such saliva is callicrein. The agent in the saliva producing the hypertensive effect is unidentified.

Ungar, G., J. L. Parrot, and A. Grossiord, 1936a. STIMULATION DE LA SÉCRÉTION GASTRIQUE PAR EXCITATION DU BOUT PÉRIPHÉRIQUE DU NERF LINGUAL. PASSAGE D'UNE SUBSTANCE ACTIVE DANS LA SALIVE [Stimulation of gastric secretion by excitation of the peripheral end of the lingual nerve. Passage of an active substance in the saliva]. *Compt. rend. Soc. Biol. (Paris)*, 121: 1077-1079.

A 2-minute period of excitation of the peripheral end of the lingual nerve in the dog,

under chloralose anesthesia and atropine, was found to initiate gastric secretion. Little or no change in gastric secretion was noted in the absence of the atropine. Gradual intravenous injection in the dog of canine saliva, secreted in response to stimulation of the lingual nerve, produced gastric secretion similar to that occurring after administration of atropine. It is considered that the two effects produced by excitation of the lingual nerve are initiated by two different chemical mediators. One, cholinergic, produces salivation; the other, probably a histamine, produces vasodilation of the tongue and submaxillary gland and stimulates gastric secretion.

Updegraff, Helen, and Howard B. Lewis, 1924. A QUANTITATIVE STUDY OF SOME ORGANIC CONSTITUENTS OF THE SALIVA. *Jour. biol. Chem.*, 61 (3): 633-648.

Comparative studies were made on a number of organic constituents of the saliva and blood of healthy men and women (students and laboratory workers). Paraffin-activated saliva was collected from 1 to 1-1/2 hrs. after a light breakfast in the amounts of 30 to 35 cc. Blood samples were obtained from an arm vein.

"1. A modification of the Folin-Wu blood method for the precipitation of protein from saliva is described. In the filtrates obtained, non-protein nitrogen, urea, ammonia, uric acid, and glucose have been determined by the usual methods.

"2. A comparison of the composition of the blood and saliva of the same individual indicates that the non-protein nitrogen of saliva averages 37.0 per cent of that of the blood; the ammonia plus urea nitrogen, 76.1 per cent; the uric acid, 40.1 per cent; and the residual non-protein nitrogen, 12.1 per cent. Of these constituents of the saliva the ammonia plus urea nitrogen most nearly equals the urea nitrogen of the blood.

"3. The relatively small quantity of residual non-protein nitrogen of the saliva in most cases would indicate that amino acid nitrogen must be present in saliva in very small amounts, if at all. The activity of the salivary glands would appear to be selective, since of the blood constituents, glucose and amino acids are not secreted in significant amounts in the saliva, while urea and uric acid readily pass into the secretion.

"4. The ammonia in saliva originates largely from the decomposition of urea. This formation of ammonia may be checked by the presence of chloroform." (Authors' summary.)

Updergraff, Helen, 1926. CONCERNING THE PRESENCE OF SUGAR IN SALIVA. *Dental Cosmos*, 68 (3): 237-239.

Tests of 68 samples of human saliva from normal individuals revealed the presence of no sugar in amounts sufficient to permit quantitative estimation. Although administration of 100-300 g. of glucose to three normal individuals produced a decided hyperglycemia, no trace of glucose was observed in the saliva one hour after administration. From these experiments and a survey of the literature the elimination of sugar in saliva is considered rare, occurring only abnormally, as possibly in advanced cases of diabetes.

Urechia, C. I., Ciocanelli, and Retezeanu, 1930. SUR QUELQUES EFFECTS DES EXTRAITS DE GLANDES SALIVAIRES [On some effects of salivary gland extracts]. *Compt. rend. Soc. Biol. (Paris)*, 104: 595-598.

Determination was made of blood calcium levels in 25 mental patients in good physical condition prior to and at 30 minute, 1-, 2-, and 3-hour intervals after injection of extracts of beef submaxillary or parotid glands. The subjects had a cup of tea and a slice of bread 2 hours prior to the test. Minor variations were found after injection of 5 cc. of extract equivalent to 2.5 g. of fresh gland. Similar tests on the same subjects showed injections of submaxillary or of parotid extracts to likewise produce only slight changes in blood P levels. Determination of blood sugar levels in 23 similar subjects showed similar injections to produce hypoglycemia with the parotid extract producing much less intense effects than the submaxillary extract. The extracts appeared to have a more powerful hypoglycemic effect than insulin. Data is given on the effects of the extracts injected into 3 diabetics. The injections were also found to produce diminution on the blood cholesterol levels of 20 patients, often to a marked degree.

Uspenskiĭ, IŮ. N., 1940. VLIĀNIE VYSOT ELBURSA NA ZHELCHEOBRAZOVANIE I DEĬATEL'NOST' SLIŮNNYKH ZHELEZ [The influence of the Elburz heights on the production of bile and on the function of the salivary glands]. *Biull. eksper. Biol. Med., Moskva*, 10 (5): 346-348.

Parotid gland function and bile production were studied in 2 fistulated dogs for 2 months at altitudes of 2200 and 4250 meters in the Elburz Mountains. Samples of saliva, stimulated by oral administration of a 0.25% solution of hydrochloric acid, were collected from the parotid fistula and salivary determinations made of the amounts of amylase, sugar, and urate present. A marked drop in salivary secretion from that observed in Moscow occurred on ascent to 2200 m., followed by a gradual return to the normal secretion rate. The rate fluctuated around normal during the first days at 4250 m. then rose markedly; hypersecretion persisted until return to Moscow. Amylase was temporarily found in the saliva after ascent to 4250 m. and reappeared again after descent to 2200 m. The concentration of salivary sugar, ranging from 12 to 17 mg.% at Moscow, rose to 24 mg.% at 2200 m. and to 39 mg.% at 4250 m. The salivary urate level rose from 7 mg.% at Moscow, to 20 mg.% at 2200 m. and to 24 mg.% at 4250 m.; the rise in urate content of the saliva paralleled that of the blood.

Uspenskiĭ, V. K., 1948. VLIĀNIE RAZDRAZHENII BRIŮSHINY VVEDENIEM V BRIŮSHINNUĬŮ POLOST' VOZDUKHA I RASTVOROV NA FUNKSIŮ SLIŮNNYKH ZHELEZ [The influence of peritoneal stimulation on the salivary glands by means of inflation of the peritoneal cavity with air or solutions]. *Sbornik Trudov Ivanovskogo Sel'skokhoz. Instituta. Kfedra normal'. i patol. Fiziol.*, 10 (2): 143-148. *Abst. Sovet. med. refer. Obozrenie, Fiziol.*, 1952 (10): 66.

The effect of peritoneal stimulation on salivary secretion was studied in dogs having permanent salivary fistulas. Determinations were made of salivary response to bread and to subcutaneous

injections of pilocarpine or morphine, as well as the salivary viscosity, dry residue and ash content of 5-minute samples of the secreted saliva. Similar determinations were made after introduction of different volumes of air or physiological solution into the peritoneal cavity. A rapid salivary response was found to peritoneal stimulation by air or liquids but no definite relationships could be established to the qualitative changes in the saliva thus secreted.

Uyeyama, Ryoji, 1940. UBER DIE ANALYSE DER TYPENSUBSTANZEN IM MENSCHLICHEN SPEICHEL [On the analysis of blood type-substances in human saliva]. *Jap. Jour. med. Sci.*, (7) 3 (3): 131*.

An analysis of the blood type substances in human saliva, made with chicken sera and immune chicken sera, indicated the presence in saliva of O, A, B, C, and T substances, species-specific antigen, and organ-specific antigen.

Vais, S. I., 1944. OB ANAPHYLACTICHESKOI REAKTSII SLIŮNNYKH ZHELEZ U SOBAKE [On the anaphylactic reaction of the salivary glands in the dog]. *Biull. eksper. Biol. Med., Moskva*, 18 (4-5): 30-33.

Author's advanced summary of Vais 1948.

Vais, S. I., 1948. OB ANAFILAKTICHESKOI REAKTSII SLIŮNNYKH ZHELEZ SOBAKI. SOOBSHCHENIE I [Concerning the anaphylactic reaction of the salivary glands of the dog. Article I]. *Fiziol. Zhur., SSSR*, 34 (4): 505-514.

Experiments were made in 12 well-fed dogs of similar weight and age. Fistulae of the parotid ducts were made in three dogs, of the submaxillary ducts in the others. After a post-operative period of 3 to 4 weeks, minimal doses of pilocarpine (0.2 - 1.0 ml.) were injected intravenously. The following characteristics of the pilocarpine secretory stimulation were observed:

The gross amount of pilocarpine-induced saliva and its organic content vary directly with the duration of secretion. This organic content very seldom exceeds 1%. A minimum of secretion coincides with a maximum content in organic substances and a sharp drop in minerals; a decrease in organic matter coincides with an increase of mineral content. The salivary glands do not show any habit-forming tendency after repeated administration of pilocarpine with 2 to 3 days intervals. The secretion of a submaxillary gland whose chorda tympani has been resected is greater and contains more organic matter than that of the normal gland. Desympathisation of the submaxillary gland lessens its sensitivity to pilocarpine: less saliva is secreted with a smaller content in organic substances.

The changes in salivary secretion during the immunisation process to a foreign serum were studied. After determination of the minimal pilocarpine dose eliciting salivary reaction, and an injection period of 4-5 weeks establishing the secretion standard, the dogs were sensitized through a subcutaneous injection of 0.2 m./kg. of horse serum. Intravenous serum injections were then given every 3 to 6 days and the pilocarpine salivation studied during the intervals. Findings, after repeated serum injections in 8 dogs, showed a shortening of the period of latency and an accelerated increase in pilocarpine salivation from the normal and [presumably in the later

stages of sensitization] from the denervated glands (with resected chorda tympani and n. lingualis); the normal glands usually manifested a quantitative increase of a more diluted saliva, while the denervated glands produced an increased amount of unchanged consistency. The author considers a direct relationship to exist between the changes in salivary secretion and the degree of animal resistance to the anaphylactic process. Absence of changes in salivation or abatement were observed precisely in those animals whose anaphylactic shock was light and delayed, on the 30 to 43rd day, after the 6th or 8th serum injection. In the anaphylactic stage, the character of pilocarpine salivary changes is determined by the degree of severity of the shock and the original functional condition of the salivary glands; a severe anaphylactic shock is accompanied by depression or complete stoppage of salivary secretion; a moderate anaphylactic shock, occurring in the middle of abundant salivation, checks this secretion; a moderate anaphylactic shock, occurring at the fading point of salivation, activates the secretion.

Vais [Weiss], S. I., 1948. OB ANAFILAKTICHESKOI REAKTSII SLIUNNYKH ZHELEZ SOBAKI. SOOB-SHCHEENIE II [Concerning the anaphylactic reaction of the salivary glands of the dog. Article II]. Fiziol. Zhur., SSSR, 34 (4): 515-524.

In a continuation of experiments on anaphylaxis in dogs (Vais, 1948 m), the action of the parasympathetic secretory nerve of the submaxillary glands was studied at different times and phases of sensitization to a foreign serum. Of 24 cases of repeated serum injection, mostly in the early stages of sensitization, the normal submaxillary glands showed an increase in salivation in 15 cases, while the denervated glands showed a change in secretion in 4 cases only. The author concludes that in these early stages of anaphylactic sensitization the secretory activation is a reaction of the central salivary center. Possibly, the salivary nervous center is influenced before the peripheral nervous-secretory network.

The results of experiments that led to an anaphylactic shock (at a later stage of sensitization) showed an almost identical increase in salivation in both the normal and the denervated glands. The author suggests that in these cases one observes an anaphylactic reaction of the peripheral nervous-secretory network. The changes in salivation are then determined by the severity of the anaphylactic shock.

Vais, S. I., and A. M. Tarnopol'skaia, 1951. SODERZHANIE SAKHARA I MOLOCHNOI KISLOTY V SLIUNE U DETEI SO ZDOROVYMI ZUBAMI I PRI MNOZHESTVENNOM KARIESE [Sugar and lactic acid in the saliva of children with healthy teeth or with multiple caries]. Stomatologiya, 1: 25-27. Abst.: Sovet. med. refer. Obozrenie, 1951 (3): 11.

The salivary contents of sugar and lactic acid were determined in 204 tests of the saliva of 62 children from 9 to 14 years of age. Sixteen of the subjects had healthy teeth; the others had single or multiple dental caries. Results indicate that the mixed saliva of children with multiple caries contains almost three times the average levels of sugar and lactic acid found in the saliva of children with healthy

teeth. The authors conclude that, besides the endogenous and exogenous causes, oral biochemical processes in particular, the sugar and lactic acid contents of saliva play a role in the etiology and pathology of caries.

Vais, S. I., and A. M. Tarnopol'skaia, 1951. SODERZHANIE SAKHARA I MOLOCHNOI KISLOTY V SLIUNE U DETEI SO ZDOROVYMI ZUBAMI I PRI MNOZHESTVENNOM KARIESE. [The sugar and lactic acid content in the saliva of children with healthy teeth or with multiple caries]. Stomatologiya, 1: 25-27.

The sugar content of saliva was studied in connection with the degree of dental caries. Examination was made of 62 children, 9 to 14 years old, with or without dental caries, all living on the same diet. 15 cc. of saliva was collected early before breakfast, without preliminary rinsing of the mouth. The sugar content was determined by the Hagendorn-Jensen method, the lactic acid by the Friedman, Cotonio and Schaffer; 240 tests were made.

In children perfectly resistant to caries the sugar content was examined 27 times. It fluctuated from 0 to 16 mg./100, with an average of 5.34 mg./100; 8 were completely negative. Very great fluctuations (0 to 14 mg./100) were observed in one and the same child on different days. In the same group of children, 25 measurements of lactic acid were made. The values fluctuated from 0 to 3.5 mg./100; only one test was negative. The figures varied from day to day in the same child, however these fluctuations were smaller and less frequent than for the sugar.

In the saliva of children with single or multiple dental caries 72 sugar tests were made. The sugar content varied from 0 to 28 mg./100, with an average of 14 mg./100, and only 3 negative tests. The fluctuations in one and the same individual were considerable. 76 measurements of lactic acid were made in this group, showing 0.24 to 7.01 mg./100, with an average of 2.2 mg./100, and marked fluctuations in one and the same individual.

Comparing the results obtained in both groups of children it was found that both the sugar and the lactic acid content were almost three times greater in the cases with dental caries than in those without. No relationship could be established among the values observed for any one individual. The author concludes that the sugar and lactic acid content are of definite significance in the pathogeny of dental caries.

Valeri, Victorio, 1954. NUCLEAR VOLUME AND TESTOSTERONE INDUCED CHANGES IN SECRETORY ACTIVITY IN THE SUBMAXILLARY GLAND OF MICE. Science, 120 (3128): 984-986.

Subcutaneous implantation of 20 mg. of testosterone propionate in powder form to 2 sets of white mice resulted in an increase in size of submaxillary gland cell nuclei due to stimulation of the gland by the hormone. Adult male mice in the first set received the testosterone 30 days after unilateral ligation of Wharton's duct. These and similar control animals which did not receive the drug were killed after 15 days; submaxillary glands were removed and fixed in Helly's fluid. Immature (15 gm.) male mice used in the second set were castrated, Wharton's ducts unilaterally ligated, and hormone was administered the following day. This set, including

both hormone-stimulated and control animals, was killed after 30 days. Results of the two sets of experiments are considered separately. Although tissues within each set were treated exactly alike, differences in handling tissues in the two sets during paraffin inclusion do not permit comparison.

Results in control animals show that ligation of Wharton's duct causes a reduction in size of the cell nuclei. Comparison of stimulated and non-stimulated tissues shows an increase in nuclear size following increased glandular activity induced by the testosterone. No significant difference in nuclear volume was seen between those of intact glands and the initially significantly smaller nuclei of duct-ligated glands. Since the nuclei of experimental and control glands respond equally to pharmacological stimulation it is concluded that diminution of nuclear volume following duct ligation is not due to cellular degeneration but to decrease in secretory activity of the salivary gland.

Vallotton, Charles F., 1945. AN ACQUIRED PIGMENTED PELLICLE OF THE ENAMEL SURFACE. I. Review of literature. Jour. dent. Res., 24 (3-4): 161-169.

An extensive review is presented of studies on anatomical and depositional (plaque) types of enamel organic coverings. The role of saliva in such plaque formation is discussed.

van den Bergh, A. A. Hymans, 1928. ON PORPHYRIN IN THE MOUTH. Lancet, 214 (5450): 281-282.

The occurrence of porphyrin, its role in the causation of fluorescence of the teeth and tongue, and the source of porphyrin in the mouth is discussed. Possible sources cited include the hemoglobin in food or in the gums, the saliva, the microbes of the teeth, and the components of food which are considered its most likely source.

Van Huysen, G., and George B. Diefenbach, 1944. REDUCING SUBSTANCES IN EXPECTORATED STIMULATED SALIVA. Jour. dent. Res., 23 (3): 191.

"One hundred ninety-one (191) samples of stimulated expectorated saliva taken from 8 individuals were examined for reducing substance content by means of the Hagedorn-Jensen method. It was found that the mean value (ΣN)/(N) of these determinations was 0.007 mg. of R.S. per 0.1 cc. of saliva. The standard deviation was calculated as ± 0.002 mg." (Complete paper.)

Van Huysen, G., and V. Bhatavadaker, 1955. THE INHIBITION OF CALCULUS FORMED IN VITRO. Jour. dent. Res., 34 (5): 733.

"Calculus formed in dissociated teeth in paraffin-stimulated saliva, renewed twice a day, can be detected microscopically with polarized light at the end of 1 week. A 0.5% solution of mucinase (Prolase 100 and Mylase L) in saliva definitely reduced calculus formation as well as saliva odor" (Author's abstract)

Van Kesteren, Mary, and B. G. Bibby, 1939. PURIFICATION OF LYSOZYME FROM SALIVA. Jour. dent. Res., 18 (3): 242.

"A summary of the properties of 2 lysozyme-like agents in human saliva, effective against

15 organisms, was given. Measurement of the concentration of a lysozyme in saliva was made by testing serial dilutions of the original saliva by the well technique. Concentration and partial purification was made by evaporation in vacuo to 1/5 the original volume, precipitation with 5 volumes of acetone, extraction of the precipitate with a buffer solution of pH at pH 7.4." (Complete paper.)

Van Kesteren, Mary, B. G. Bibby, and G. P. Berry, 1942. STUDIES ON THE ANTIBACTERIAL FACTORS OF HUMAN SALIVA. Jour. Bacteriol., 43 (5): 573-583.

A study was made of the mode of action and of the nature of the antibacterial factor of stimulated and unstimulated saliva using 15 species of bacteria previously found to be susceptible to the inhibitory action of saliva. The effects of filtration, heat, ultraviolet radiation, storage, freezing and thawing, adsorption, and various chemicals (acetone, acetic acid, chloroform) on the antibacterial factor were tested. Attempts were also made at the concentration and purification of the antibacterial agents. Results suggested that saliva contains at least 2 antibacterial agents. One of these agents resembled lysozyme while the second differed from lysozyme in most of its properties.

Varady, J., and G. Szanto, 1940. UNTERSUCHUNGEN ÜBER DEN NITRITGEHALT DES SPEICHEL, DES MAGENSAFTES UND DES HARNES [Determinations of the nitrite content of the saliva, the gastric juice, and the urine]. Klin Wochenschr., 19: 200-203.

Determinations were made of the nitrite content in samples of mixed saliva, gastric juice, and urine collected from hospital patients. The Ilosvay-Gries naphthylamine sulfanilic acid reaction was used in the determinations, with color intensities of test samples compared to standards of known NO_2 concentrations. Results show the amounts of salivary nitrite to range from 28 to 90 ug. and to average 50 ug. in salivary samples from 14 partly-convalescent patients who had taken no nitrite-containing medicine. No nitrite was detected in salivary samples with untreated hypertonia, while salivary excretion of nitrite at a high rate was found in samples of saliva from hypertonia patients who has received treatment including nitrite-containing medicines. Determinations were also made in 15-minute samples of saliva, collected for 1.5 hours after subcutaneous injection of 0.01% of pilocarpine. The nitrite content was found to drop sharply after 15 minutes of salivary secretion and then decrease gradually during the following half-hour; a rise in the salivary nitrite level after 45 minutes, corresponding to a decrease in the salivary rate of secretion, did not reach the initial nitrite level. The tests indicate an inverse relationship between salivary rate of flow and nitrite concentration; salivary excretion of nitrite is apparently uninterrupted, the observed decrease in nitrite concentration being due to increase in salivary volume. Results of the nitrite determinations in other body fluids are presented and discussed.

Vas'ko, G. N., 1927. KHIMICHESKIE I FERMENTATIVNYE IZMENENIYA SLIČNY PRI ZHELUDOCNYKH ZABOLEVANIYAKH I NEKOTORYKH PROFESSIONAL'NYKH OTRAVLENIYAKH. [Chemical and fermentative salivary

changes in gastric diseases and some occupational poisonings]. Moskovsk. med. Zhurn., 9: 10-13 (Abstract: Tsentr. Med. Zhurn., (1-6), 1929, : 987-988.

The chemical changes in saliva were studied in 51 people: 5 cases in healthy individuals with normal gastric acidity; 16 cases of occupational, acute or chronic poisoning with mercury, lead, or paranitroanilin; and 30 cases of gastric diseases: 15 of hyperacidity, 5 of hypoacidity, and 10 of achylia.

The saliva was collected from the rinsed mouth before eating, its pH determined by the Michaelis method, the potassium thiocyanate content by Autenrith and Funk, and the content in chlorides and ptyalin by Wohlgemuth.

Results showed no relationship between the pH of saliva and the condition of the gastric juice or gastric diseases, the pH of saliva fluctuating between 7.2 to 7.8. In the occupational poisonings the pH was higher.

The potassium thiocyanate content fluctuated from 0.01 to 0.072/1000; in the saliva of smokers it was two to three times higher than in non-smokers. In cases of hyperacidity a higher thiocyanate content was observed; in hypoacidity and achylia, a lower content. In cases of mercury poisoning the thiocyanate content did not exceed 0.02/1000, in the other cases of occupational poisonings the figures varied.

No relationship was found between the content in chlorides and gastric secretion.

The ptyalin content of saliva increases parallel with gastric acidity. In cases of poisoning with mercury, lead or paranitroanilin, a sharp decrease in ptyalin was observed.

Vergei, A. P., and N. F. Vorontsova, 1955. NARUSHENIE FUNKTSII SLIUNNYKH ZHELEZ PRI ORGANICHESKIKH ZABOLEVANIYAKH GOLOVNOGO MOZGA [Disturbance of salivary gland function in organic diseases of the brain]. Abst.: Sovet. med. refer. Obozrenie, Stomatol., 1955 (8): 5.

The relation of asymmetric parotid secretion to cerebral injury was studied in 25 subjects, including 15 with hypertonic vascular disease, 4 with cerebral arteriosclerosis, 2 with lateral amyotrophic sclerosis, and 4 without organic injury of the brain. Salivary flow was stimulated by 0.5% citric acid irrigation of the oral mucosa at a rate of 10 ml./min. for 3 minutes; the amount of saliva was measured during and for 3 minutes after stimulation. Pilocarpine saliva was measured for an hour after subcutaneous injection of 1 ml. of a 1% pilocarpine solution. Bilateral salivary secretions were recorded simultaneously through bilateral application of Lashley caps. Various disturbances in salivary flow were observed, dependent on the character and location of the brain injury.

Vieuchange, J., 1935. RECHERCHE D'UN VIRUS DE GROUPE ENCEPHALITOGENE DANS LA SALIVE DES SINGES EN CAPTIVITE [Studies on a virus of the encephalitogenic group in the saliva of captive monkeys]. Compt. rend. Soc. Biol. (Paris), 118 (6): 512-514.

Salivas or saliva filtrates of nine monkeys (previously used in laboratory experiments on Schilder-Fox disease--4, poliomyelitis virus--4, and encephalitis virus, strain U.S.A.--1, but all remaining perfectly healthy) were inoculated into

either the cornea or the brain of rabbits. None of the salivas contained a herpeto-encephalitic virus pathogenic to the rabbit.

Ville, J., and W. Mestrezat, 1907. ORIGINE DES NITRITES CONTENUS DANS LA SALIVE: LEUR FORMATION PAR REDUCTION MICROBIENNE DES NITRATES ELIMINES PAR CE LIQUIDE [Origin of nitrites contained in saliva; their formation by microbial reduction of nitrates eliminated by this liquid]. Compt. rend. Soc. Biol. (Paris), 63 (27): 231-233.

Experiments showed that pure parotid and submaxillary saliva taken directly from the ducts contained nitrates but no nitrites. Buccal saliva, however, always gave a positive nitrite test. A sodium nitrate solution held in the mouth one minute showed presence of nitrite. Similar results were obtained more slowly by dipping the tongue into the solution for a few moments or by wiping the tongue with cotton. Nitrate reduction ceased upon heating or addition of antiseptics.

A micro-organism was isolated from saliva which reduced nitrates *in vitro*.

Ville, J., and W. Mestrezat, 1908. SUR LES VARIATIONS DE LA REDUCTION MICROBIENNE DES NITRATES SALIVAIRES [On the variations of microbial reduction of salivary nitrates]. Compt. rend. Soc. Biol. (Paris), 65 (25): 66-68.

Variations occur in the nitrate reduction to nitrites by bacteria in the mouth. In general the reaction is weakened after a meal, to be recovered 2 or 3 hours later. Variations were also noted in the same subject at different times. It was established that bacteria could also break down nitrites as soon as they were formed, and so mask the formation of the nitrites. Variations thus depended upon the bacterial constitution of the buccal flora.

Ville, M. J., and M. W. Mestrezat, 1912. DE L'ORIGINE BUCCALE DES OXYDASES, DES PEROXYDASES ET DES SUBSTANCE PEROXYLITIQUES DE LA SALIVE MIXTE [On the buccal origin of the oxydases, peroxydases, and peroxylytic substances of mixed saliva]. Assoc. franc. pour l'Avance. Sci., Compt. rend., 41: 261-263.

Pure, stimulated parotid saliva of 3 subjects, obtained by catheterization of Stenson's duct, was found to be totally free of oxydase, peroxydase, and perosylytic substances; methods of analysis are described. The authors conclude that these substances are of exclusively "buccal" origin.

Visscher, Maurice B., 1938. COMPARATIVE STUDY OF SALIVARY AND OTHER SECRETIONS. Jour. dent. Res., 17 (4): 293-294.

Examination of the saliva and other secretions (urine, aqueous humor) of 15 anesthetized dogs showed the pH to vary between 7.25 and 8.58. In dye secretion studies, employing 7 basic and 8 acid dyes, saliva contained 1 of the basic and 3 of the acid dyes, suggesting that the salivary glands are not typical alkali secreting glands.

Vitte, G., 1937. SUR LA PRESENCE CONSTANTE ET EN QUANTITE VARIABLE DU BROME DANS LA SALIVE HUMAINE [On the constant presence and variable quantity of bromine in human saliva]. Compt. rend. Soc. Biol. (Paris), 124: 1227-1228.

The bromine of salivas of healthy adults was determined by the method of Chelle and Vitte for

urine [Bull. des Trav. de la Soc. de Pharm. Bordeaux, 1935: 179]. The bromine content of the salivas of 14 persons, obtained during the day, ranged from 0.9 to 6 mg./liter saliva; that of 10 salivas, obtained at night, from 0.2 to 1 mg./liter; and that of 10 salivas obtained in the afternoon, from 1.5 to 7.1 mg./liter.

Vivanco K., A., A. Vila I., and J. Asenjo C., 1946. CONTRIBUCION AL ESTUDIO DE LA FLORA BUCAL E INDICE BACTERIANO ORAL DEL DESDENTADO ADULTO EN RELACION CON EL USO DE APARATOS PROSTÉSICOS [Contribution to the study of the flora of the mouth and the oral bacterial index of the toothless adult in relation to the use of prosthetic appliances]. Rev. dent. Chile, 38 (8): 339-344.

The oral bacterial flora was studied in 110 toothless adults, 50 of whom wore dental prostheses. The mouth was flushed with 75 cc. of sterile physiological saline solution and the washings were recovered in sterile bowls. 1 cc. portions of 5% dilutions of the washings were added to liquid or solid culture media (broth, tomato broth, saline glucose solution, milk, simple agar, ascites agar, blood agar, and tomato agar). The results of culturing were used to compute the oral bacterial index [method not given].

Toothless subjects without artificial dentures had an average bacterial index of 600.6, those with dentures, 3,0354.6. The bacterial flora of the mouths without prostheses invariably contained three aerobic species, Staphylococcus [Micrococcus] pyogenes, Streptococcus pyogenes, and Lactobacillus acidophilus. Bacillus subtilis, Sarcina, pneumococcus [Diplococcus pneumoniae], Diplococcus [Neisseria] catarrhalis, and Diplococcus [Neisseria] crassus, all aerobes, were observed with less constancy.

Subjects with prostheses had a basic mouth flora similar to that of individuals without prosthetics pieces. In many cases, however, the presence of anaerobic forms, Leptothrix buccalis [?] and sometimes B. fusiformis [Fusobacterium plauti-vincentii] was determined.

The numbers of oral bacteria were increased in individuals practicing inadequate hygiene of the mouth and of the dentures. Smoking habits likewise increased the bacterial numbers.

Vladesco, R., 1928. SUR LA PRÉSENCE DE L'URÉE DAN LA SALIVE; SES RAPPORTS AVEC L'URÉE SANGUINE [On the presence of urea in saliva; its relation to urea in the blood]. Compt. rend. Soc. Biol. (Paris), 99 (23): 434-436.

Measurements were made of the amount of urea found in the saliva and blood of man, the dog, cat, fox, and horse. Saliva was collected from the human mouth without stimulation or prior rinsing while saliva in the animals was elicited by injection of either pilocarpine or arecoline. The tests, considered too few to be conclusive, showed a higher level of urea in the saliva of man than in the blood. The reverse was true in the animals tested.

Vladesco, R., and M. Popesco, 1929. TENEUR DE LA SALIVE DE L'HOMME EN URÉE ET EN SELS D'AMMONIUM SOUS L'INFLUENCE DE LA PILOCARPINE. RÔLE DES GLANDES SALIVAIRES DANS LE MAINTIEN DE LA RÉSERVE ALCALINE [The urea and ammonium salt content of human saliva under the influence of

pilocarpine. The role of the salivary glands in the maintenance of the alkaline reserve]. Compt. rend. Soc. Biol. (Paris) 101: 306-308.

Determinations were made of the amounts of nitrogen titratable by hypobromite, of ammonium nitrogen, and of urea in naturally secreted human saliva and in human saliva secreted after injection of 6 to 10 mg. of pilocarpine. Determinations were also made of the blood urea levels before and after the pilocarpine.

The tabulated results of the measurements before pilocarpine show the saliva to contain little or no urea indicated by xanthidrol; generally the titratable N levels are greater than, and the ammonia N levels less than the urea levels of the blood. Administration of pilocarpine results in a marked increase in salivary urea, and marked decreases in both the titratable and the ammonia N levels.

A hypothesis is advanced, suggesting that the salivary glands hydrate urea and secrete it in the form of ammonia salts to permit retention of base ions by the organism.

Vladesco, R., and M. Popesco, 1931. NOUVELLES RECHERCHES SUR L'URÉE SALIVAIRE [New studies on salivary urea]. Compt. rend. Soc. Biol. (Paris), 107: 862-864.

Urea, and to a lesser extent ammonia N, were detected by means of xanthidrol tests in chorda and pilocarpine submaxillary saliva of the dog as well as in its parotid saliva after injection of either pilocarpine or urea into the external saphenous vein. Urea was also detected in the parotid saliva of the horse.

Vladesco, R., 1932. SUR L'HYDROLYSE DE L'URIE SOUS L'INFLUENCE DE LA SALIVE DE L'HOMME [On the hydrolysis of urea under the influence of human saliva]. Compt. rend. Soc. Biol., 109: 1001-1002.

Examination of the salivas of a number of persons (total not given) of various ages, both sexes, and collected at different times of the day, indicated the presence of an enzyme which converts urea into ammonium salts. This enzymatic action varied greatly among individuals, and in the same individual under various conditions, but no correlations could be established.

Vladesco, Radu, 1936. SUR LA PRÉSENCE DE L'ACIDE LACTIQUE DANS LA SALIVE [On the presence of lactic acid in saliva]. Compt. rend. Soc. Biol. (Paris), 121: 275-276.

Measurements of the lactic acid content of human saliva were made of a filtrate obtained after treating saliva, collected after a mouth rinse, with a copper sulfate-potassium ferrocyanate solution. Results of 12 samplings show a variation in lactic acid content from 3.982 to 13.610 mg./100 cc. saliva. Measurements made after institution of more rigorous methods of collecting salivary samples to avoid possible contamination showed in one case, previously found to have 3.982 cc./100 cc., the presence of 3.718 mg. lactic acid /100 cc. The cannulated saliva of a dog was found to have 4.390 mg. lactic acid /100 cc. It is concluded that lactic acid is a salivary constituent originating at least in part from the lactic acid of the blood.

Vladesco, Radu, and L. Bellea, 1938. LE POTASSIUM DANS LA SALIVE HUMAINE [Potassium in

human saliva]. *Compt. rend. Soc. Biol. (Paris)*, 129: 329-330.

Determinations of the amounts of potassium in the salivas of 51 subjects are tabulated, and show this substance to vary from 308.6 mg./l. of saliva to 1310 mg./l.

Vladesco, Radu, 1938. LE CHLORE DANS LA SALIVE DE L'HOMME [Chloride in human saliva]. *Compt. rend. Soc. Biol. (Paris)*, 128: 317-319.

Determinations were made of the chloride content of unstimulated human salivas from 40 healthy subjects, male and female, and varying in age from 7 to 50 years. The chloride content was found to vary from 0.664 g. of NaCl/1000 cc. of saliva to 1.971 g./1000, averaging 1.198 g./1000. Details are given concerning the method used to clarify the saliva and measure the amount of chloride present.

Vladesco, Radu, and Georges Nichita, 1939. MODIFICATIONS DE LA COMPOSITION DE LA SALIVE ET DU SANG PRODUITES PAR LA PILOCARPINE [Modifications of the composition of saliva and of blood products by pilocarpine]. *Compt. rend. Soc. Biol. (Paris)*, 130: 1154-1156.

A study was made of the changes in the chloride content of submaxillary saliva and of blood produced by intravenous injection of pilocarpine hydrochloride in the chloralosed dog. Administration of 0.5 m.g/kg. of pilocarpine produced an increase in salivary chloride accompanied by a drop in the chloride content of the blood. The chloride content of this pilocarpine-stimulated saliva was greater than chorda saliva from the same dog. The freezing point of pilocarpine saliva was found to be lower than chorda saliva.

Volker, Joseph F., 1939. THE EFFECT OF SALIVA ON BLOOD COAGULATION. *Amer. Jour. Orthodont. and oral Surg.*, 25 (3): 277-281.

The supernatant fluid of centrifuged, unstimulated human salivas was added to blood samples from each of three dogs; the clotting time was studied. The average clotting time for 2 cc. blood alone ranged from 4 to 5-1/2 minutes; for 2 cc. blood with 0.2 cc. saliva, from 2-3/4 to 4 minutes; for 2 cc. blood with 0.5 cc. saliva, from 2 to 3 minutes, and for 2 cc. blood with 1.0 cc. saliva, from 1-1/4 to 1-1/2 minutes.

The salivary clotting agent was little or not affected by boiling for less than 5 minutes nor by filtration (Berkefeld). When the filtrate protein was precipitated and redissolved in distilled water (described in detail), the solution nevertheless exhibited coagulation-accelerating properties similar to whole saliva.

In vitro dilution of the blood (with water or Ringer's solution) decreased the coagulation time. To determine whether saliva hastens the neutralization of the antithrombin, injections of Witte's peptone were administered intravenously to 5 dogs to increase the antithrombin content of the blood. Samples of blood thus treated clotted in about 48 hours; the addition of saliva decreased the coagulation time to 10-20 minutes. This, the author states, suggests that saliva accelerates blood coagulation by neutralization of the antithrombin.

Apparatus used is described in detail.

Volker, J. F., R. F. Sognaaes, and B. G. Bibby, 1941. STUDIES ON THE DISTRIBUTION OF RADIOACTIVE FLUORIDE IN THE BONES AND TEETH OF EXPERIMENTAL ANIMALS. *Amer. Jour. Physiol.*, 132 (3): 707-712.

Four adult cats, weighing from 2.6 to 4.0 kilo, were given intravenous injections of sodium fluoride, containing F¹⁸, in physiological saline solution. Submaxillary saliva, stimulated by electrical charge to the chorda tympani, was collected from the cannulated duct. After collection of blood samples the animals were killed and samples of salivary gland and other tissues were obtained. Calculation of the total doses of fluoride secreted showed the greater portion of the salivary and urinary fluoride to be excreted within the first 30 minutes, the period during which the blood level of the fluoride is correspondingly high. The percent of the total dose of fluoride in the saliva varied from 0.054 to 0.11.

Volker, J. F., and D. M. Pinkerton, 1948. DISAPPEARANCE FROM THE MOUTH OF INGESTED GLUCOSE. *Jour. dent. Res.*, 24 (3/4): 203-204.

"The method of Folin and Malmos has been utilized to study the presence of reducing substance in resting saliva. The average value for salivary reducing substances (calculated as glucose) for a group of 30 individuals was approximately 20 mg. %. The disappearance of ingested glucose fed in the form of chewing gum, hard candy and chewy candy was determined in a group of 12 people. The rate of disappearance varied considerably from person to person but in general was most rapid after gum chewing and least rapid in chewy candy. The maximum concentration of salivary sugar is reached within 5 minutes and the return to normal is usually complete after 30 minutes. Concentrations as great as 4,000 mg. % have been recorded for certain types of candy." (Authors' abstract)

Volker, J. F., and Dorcas Pinkerton, 1946. SOME OBSERVATIONS ON THE FERMENTATION OF CARBOHYDRATES BY SALIVA. *Jour. dent. Res.*, 25 (3): 172.

"Studies have been made of the hydrogen ion concentration and titratable acidity of the various carbohydrate saliva mixtures. It has been established that the rate of fermentation of sucrose and glucose is comparable and somewhat greater than that for starch. However, the latter in turn is considerably greater than certain of the dextrins. The fermentation of the concentrations of sucrose and glucose varying from 100 mg to 10,000 mg %, incubated with saliva, has been investigated. It has been shown that through most of this range, acid production is independent of the concentration. It is believed that it is not necessary to have polysaccharides and disaccharides broken down to glucose prior to fermentation. It is conceivable that the more complex carbohydrates undergo a direct phosphorylation. The ability of wheat and navy bean extracts to inhibit the saccharification of starch has been demonstrated." (Complete paper.)

Volker, J. F., and D. M. Pinkerton, 1947. ACID PRODUCTION IN SALIVA-CARBOHYDRATE MIXTURES. *Jour. dent. Res.*, 26 (3): 229-232.

Unstimulated-saliva samples, collected from carious persons, were incubated at 38°C. with addition of various carbohydrate solutions (i.e.

glucose, sucrose, fructose, white and yellow dextrin, starch, etc.). The rate of carbohydrate breakdown by saliva, and the influence of carbohydrate or salivary concentration on this process were studied, as was the susceptibility of raw and refined carbohydrates to bacterial action. Methods are fully described.

The acid production in mixtures of saliva and sucrose, starch, or glucose proceeded at similar rates. The authors suggest that the degradation of sucrose and starch may be due to direct phosphorylation and that these carbohydrates need not necessarily be converted to glucose. Two pentoses (arabinose and xylose) were completely resistant to salivary action. In mixtures of glucose, sucrose, and concentrated salivary debris, "considerable" acid production occurred within 15 minutes. It appeared that the effect of saliva in carbohydrate degradation depends principally on the relative amount of salivary debris. The rate of acid formation of various raw carbohydrates was similar to that of refined sugars.

Volker, J. F., and D. M. Pinkerton, 1947. SOME OBSERVATIONS ON THE CLEARANCE OF GLUCOSE FROM THE ORAL CAVITY. *Jour. dent. Res.*, 26 (1): 9-13.

The normal glucose levels and the rate of clearance of ingested glucose from the oral cavities of an all male group were studied. An adaptation of the Folin-Malmros micro method for blood sugar examination and a Cenco photometer were employed.

The average glucose level (28 persons) was approximately 20 mg./100 cc., ranging from 13 to 30 mg./100 cc. The daily variation (12 persons) over a 5-day period was from 8 to 33 mg./100 cc. The range of individual averages was from 14-22 mg./100 cc.

The average salivary glucose concentration of 87 persons following ingestion of food and confections was observed. The maximum glucose concentration (377-1909 mg./100 cc.) occurred within 5 minutes, returning to near-normal within 30 minutes.

The rate of clearance of glucose after ingestion of army field rations (biscuits and drink, followed by candy) was studied in three individuals. High concentrations were observed for approximately 1-1/2 hours after ingestion. The lowest glucose value during this time was about 14.5 mg./100 cc.; the highest, 3,480 mg./100 cc.

The rate of glucose clearance after ingestion of large size (38 g.) lollipops was studied in 4 persons. Again, high concentrations were observed for a one-hour period, decreasing considerably after two hours. The lowest glucose value during this period was approximately 700 mg./100 cc.; the highest, 6,000 mg./100 cc.

Volker, J. F., and D. M. Pinkerton, 1947. FACTORS INFLUENCING ORAL GLUCOSE CLEARANCE. *Jour. dent. Res.*, 26 (3): 225-227.

A study was made of the rate of glucose clearance in the oral cavities of 6 young adults (3 males and 3 females). The individuals ingested 500 mg. glucose in 1) a glucose wafer, dissolved by sucking, 2) a glucose cube (cake) eaten at normal rate, 3) a one-minute mouth rinse of 4 cc. aqueous solution of glucose, and 4) a gum base to be chewed. The clearance, measured 2, 9, 16, and

30 minutes after ingestion, was most rapid for the eaten cake and the rinse solution; it was slowest for the sucked wafer. In the chew gum-base experiment, values were comparatively low during the first three periods.

Volker, J. F., and D. P. Murray, 1947. THE ACTION OF SALIVA ON STARCH AND GLUCOSE. *Jour. dent. Res.*, 26 (6): 449.

"The 'in vitro' rate of acid production of refined starch saliva mixtures has been found to parallel that of glucose saliva. Two overall steps seem necessary for acid production from starch: (1) starch breakdown to reducing sugars (2) sugar conversion to acid. If the first reaction is extremely rapid and the second limited, acid production from starch saliva and glucose saliva mixtures should be similar. Theoretically, if the breakdown of starch to reducing sugars could be drastically impeded, the rate of acid production of starch saliva mixtures might be reduced. Kneen and his associates have shown that natural wheat starch has a tryptophane containing amylase inhibitor and Turner has shown the ability of pure tryptophane to do likewise. We have shown that various plant hormones are effective in inhibiting starch breakdown to reducing sugars but, they do not influence the ability of saliva to break down glucose and sucrose to acid.

"The 'in vitro' rate of acid production of sucrose saliva mixtures has been found to parallel that of glucose-saliva. Two possibilities exist (1) the oral enzymes convert sucrose to acid without intermediate hexose formation (2) some of the sucrose in sucrose saliva mixtures is immediately converted to glucose and as such is used in acid formation. We have been able to show by in vitro experiments the presence of reducing sugars within 2 minutes after the addition of sucrose to fresh saliva. The level of glucose in saliva sucrose mixtures is dependent on the initial concentration of sucrose and tends to remain at a stabilized level over periods of at least several hours. If salivary samples are taken immediately after the ingestion of a sucrose ration, measurable quantities of reducing substance can be shown to be present." (Complete paper.)

Volker, J. F., 1950. COMPOUNDS CAPABLE OF PLANT AMYLASE INHIBITION. *Science.*, 112 (2898): 61:

Salivary amylase has been found to be effected by the anti-amylolytic ability of the indole nucleus-containing plant hormones when they were added to refined starch in concentrations as low as 0.01%. This anti-amylolytic ability was also true of 2,4 dichlorophenoxyacetic acid, triiodobenzoic acid, naphthalene acetic acid, naphthoxyacetic acid, and nicotinic acid when they were used in mixtures containing salivary amylase.

Volker, J. F., 1950. SOME OBSERVATIONS ON THE ACTION OF SALIVA ON SUCROSE. *Jour. dent. Res.*, 29 (5): 680-681.

"It has been shown that when sucrose is added to the diet of the Syrian hamster, it is at least as effective as glucose in causing experimental caries. Furthermore, it has been demonstrated that immediately following the ingestion of sucrose *in vivo* enamel surface acid production occurs. These considerations point to the importance of understanding the mechanism of oral

sucrose degradation. The conversion of sucrose by salivary enzymes to reducing substances, presumably glucose, has been the subject of *in vivo* and *in vitro* study. Varying quantities of sucrose have been added to pooled salivary samples and, at intervals from 1 minute up to 2 hours, aliquots have been analyzed for the presence of glucose. With this method it has been possible to show the immediate appearance of glucose in saliva-sucrose mixtures and its persistence at approximately the same level during the duration of the experiment; for example, if 1 per cent sucrose is added to 10 cc. of fresh saliva, the reducing substance concentration increases from 15 mg. per cent to 70 mg. per cent within the first 2 minutes and remains at this level for the duration of the experiment (30 minutes). If 10 per cent sucrose is added to 10 cc. of pooled saliva, an increase in reducing substance concentration from approximately 15 mg. per cent to 200 mg. per cent occurs within 2 minutes and persists for the duration of the experiment (30 minutes). Similarly, if 1 Gm. of a ration containing 25 per cent sucrose but no glucose is ingested, a salivary glucose level of 150 mg. per cent is found within 2 minutes." (Complete paper.)

Vollenbruck, H., 1937. *UNTERSUCHUNGEN ÜBER DEN ALKOHOLGEHALT IM BLUT UND IM SPEICHEL DES MENSCHLICHEN KÖRPERS* [Examination of the alcohol content in the blood and saliva of the human body]. *Naunyn-Schmiedeberg's Arch. exper. Pathol. und Pharmakol.*, 187 (6): 731-736.

The over-all salivary alcohol curve and the blood alcohol curve were determined after ingestion of various amounts of alcohol and food. The quantity of alcohol ingested ranged between 0.58 and 1.3 g. per kg. body weight. The experiment was conducted on an empty stomach, after breakfast, and after dinner. On an empty stomach and after breakfast the alcoholic content of both blood and saliva were in conformity, but after dinner this was not completely the case. However, after a period of 6 to 8 hours after ingestion both curves were equal. Blood pressure decreased in each case but it returned to normal at the end of the experiment.

Volovin, 1929. *O SOOTNOSHENII USLOVNOI I BEZUSLOVNOI SEKRETSII SLIŬNY NA PROCHNO OBRAZOVANNYKH USLOVNYKH REFLEKSAKH* [On the correlation of the conditioned and unconditioned salivary secretion on the basis of well-established conditioned reflexes]. *Kazansk. med Zhur.*, No. 2, Abst: *Odontol. i Stomatol.*, Moskva, 7 (9): 44-45, 1929.

Prolonged and systematic observation was made of conditioned salivary reflex activity, in experimental animals having well-established conditioned reflexes, in response to various analyzers (tactile, optical, acoustic). Considerable variation was found in the stimulation condition of the cerebral cortex, interpreted from high and low salivary rates of flow which are based on a uniform unconditioned salivary secretion. A decrease in the unconditioned salivation was observed only after complete inhibition of considerable portions of the cortex following disappearance of all conditioned salivary reflexes. The relationships between conditioned and unconditioned salivary secretion is considered to be

a rather accurate indicator of the functional condition of different portions of the central nervous system.

Vorob'eva, N. N., and P. A. Pasternak, 1956. *OPSONO-FAGOTSITARNYE POKAZATELI V SLIŬNE BOL'YKHX RAZLICHNYMI FORMAMI GINGIVITOV* [The opsonic index of the saliva of patients with various forms of gingivitis]. *Stomatologiya*, 2: 59-60.

Determinations were made of the opsonic index of the saliva of 20 normal subjects and of 47 subjects having catarrhal, hypertrophic, ulcerous, or symptomatic types of gingivitis. The opsonic index, calculated from the observed phagocytosis in an incubated mixture of equal portions of the filtered saliva, defibrinated human blood and a 24-hour culture of golden staphylococcus, was less than 1.0 in all salivary samples from healthy mouths. The index was found to vary in salivary samples from subjects having gingivitis, with regard to duration of the disease and to their general health. The index was 2 to 3 times higher than normal in subjects having acute or subacute gingivitis but otherwise in general good health. The index was 2 to 3 times lower than normal in subjects having protracted gingivitis; a low index was also found in gingivitis patients having low organic resistance to other disease, and was extremely low in 2 psychoneurotic patients with catarrhal gingivitis for 1 to 3 weeks.

Vorster, DeWet, 1929. *THE PENETRATIVE POWER OF THE BACTERICIDAL RAYS IN THE ULTRAVIOLET PART OF THE SPECTRUM, AS EMITTED BY CARBON C.* *Jour. dent. Res.*, 9 (5): 641-651.

The penetrability of saliva to bactericidal rays was studied. Saliva samples, exposed for 4 to 30 minutes to ultraviolet rays emitted by a sunlamp using National Therapeutic Carbon C as electrode, showed no signs of bacterial inhibition, even at the end of 30 minutes. Controls (consisting of *Staphylococcus aureus* suspended in sterile water) showed complete destruction of bacteria after 4 minutes. It is therefore concluded that saliva is opaque to lethal rays (p. 647).

Voss, Otto, 1931. *ÜBER EINE TRYPSINARTIGE PROTEASE IM SEKRET DER MENSCHLICHEN PAROTISDRÜSE* [On a trypsin-like protease in human parotid secretion]. *Hoppe-Zeyler's Zeitschr. f. physiol. Chemie*, 197 (1): 42-54.

Studies of parotid saliva samples from 13 persons indicated the presence of a protolytic enzyme in amounts varying considerably from individual to individual. The enzyme was most active in yellowish, viscous, and turbid saliva. In centrifuged parotid saliva, the enzyme was contained in the supernatant saliva, while in mixed saliva, the enzyme action was shifted to the sediment.

In two tests, the inhibitory action of the sublingual-submaxillary secretion and of mixed human saliva on parotid protease was studied. A slight inhibition may possibly have been exerted by the former, but was totally lacking in the latter.

Six tests showed the optimum pH for parotid protease activity to be 8.0, indicating a trypsin-like nature.

This study and those of Scheer on the presence of a fat-splitting enzyme in saliva (Cf. Scheer,

1928m, 1928n) suggest a similarity between the parotid gland and the pancreas, more so than between any other salivary gland and that organ.

Vulfson, S. G., 1898. BABOTA SLIUNNYKH ZHELEZ [The work of the salivary glands]. Bol'nich. Gazeta Botkina, St. Petersburg, 9 (20): 881-886.

Investigation of salivary gland function in fistulated dogs showed qualitative and quantitative differences in saliva secreted in response to food, chemical, or mechanical stimuli.

Vulfson, S. T., 1897. O PSICHICHESKOM VLIYANIY V RABOTE SLIUNNYKH ZHELEZ [Psychological influence on the function of the salivary gland]. Bol'nich. Gazeta Botkina, St. Petersburg, 8 (45): 1740-1742.

Investigation of psychological aspects of salivary food and defense reactions in fistulated dogs showed hunger or thirst acting alone to elicit no saliva, while presentation of food or liquid to the fasting animal did produce salivary flow varying in rate with the type of substance offered. Presentation of H₂S elicited saliva having a very low dry residue content, apparently as a defense response and acting as a mouth rinse.

Vulpian, ___, 1897. SUR L'ANTAGONISME RÉCIPROQUE DE LA PILOCARPINE ET DE L'ATROPINE [On the reciprocal antagonism between pilocarpine and atropine]. Compt. rend. Soc. Biol. (Paris), 31, Compt. rend.: 132-134.

Subcutaneous injection of pilocarpine hydrochloride (10 mg.) into a curarized dog produced abundant parotic, submaxillary, and sublingual salivation after 2-3 minutes. These secretions were stopped by a similar injection of 1.5 mg. of atropine sulfate. When a third injection, a concentrated solution of pilocarpine, was administered directly to the right submaxillary gland, salivation of that gland and of the sublingual was renewed to some extent.

Vvendenskii, N. E., 1893. OTDELENIE SLIUNY I ELEKTRICHESKOE RAZDRAZHENIE [Salivary secretion and electrical stimulation]. Vrach, St. Petersburg, 14 (4): 89-90.

The relationship of the chorda tympani to the submaxillary gland was studied in dogs with a view of determining to what degree the rules established by the author in regard to motor nerves can be applied to others, in particular secretory nerves. To measure the amount of saliva secreted per time unit, the salivary duct was connected with a graded burette filled with physiological solution by means of a rubber tube opening in its side. A long glass thread, borne by a cork float, extending out of the burette through a narrow hole in the lid, and bent at a right angle, registered the level of secretion on a cylinder provided with the scale of the burette. The weight of the cork float and glass thread were made to coincide with the solution level; it then followed every movement of the solution very accurately. The solution level was ascertained at the height of the dog's gland before the experiment and equaled to zero. The stimulation threshold was determined and the stimulation chosen accordingly. The first two stimulations have to be left out of consideration. Different power, frequencies and duration of stimulation were used.

In a first series of experiments the nerve was stimulated during 0.5 minute periods, at 4.5 minute intervals. The optimum frequency was found to be about 40 strokes/second; this frequency shifting downward as the gland is exhausted. The secretion curve rises very rapidly, and later decreases gradually. For stimulations below the optimum frequency, the curve rises in a straight line, but very slowly. For stimulations much above the optimum (100-250 strokes/sec.), the curve rises first rather rapidly, then changes abruptly into a straight line parallel to the absciss.

In a second series of experiments, prolonged stimulations (2 to 3 min.) were applied at 15 min. intervals. When a lower frequency was applied, after a high-frequency stimulation had produced prolonged stupor and cessation of secretion, the gland became again able to secrete considerably. If these stimulations were below the optimum, a return to higher frequencies showed that the gland, still reacting under the influence of a lower frequency, obtained the temporary ability to respond to a higher frequency, which was indicated by a short increase in secretion.

After changing the power of stimulation, it was found that the gland which had ceased to secrete after strong and frequent stimulations, responded again when the power was lowered. All these changes take place after a short period of latency.

These facts show clearly that the cessation of secretion after strong and frequent stimulations is not due to the exhaustion of the gland. In order to prove that it is due to inhibition, a long section of the chorda and the lingual nerve was exposed in a large dog, and 2 pairs of electrodes placed on them, at a maximum distance from one another, in the best conditions of isolation. After applying the optimum or suboptimum frequency to the lower pair of electrodes, the secretion elicited by this stimulation either stopped completely or slowed down when the pessimum stimulation began to act through the upper pair of electrodes; when the pessimum stimulation ceased, the secretion reappeared.

Since the properties of all nerve stems are alike, it is to be assumed that in the secretory nerve it is also the endings which are depressed in pessimum stimulations, as was shown by the author in regard to motor nerves. It is not seen yet, whether Langley's cells or the secretory elements are affected as well.

The results showed a complete parallelism with those obtained by the author earlier in the neuro-muscular system, with a difference only in quantity. The secretory apparatus is more sluggish, therefore the corresponding reactions develop slower; on the other hand, application of low frequencies elicit such reactions as are obtained in the neuro-muscular system only at higher frequencies.

Vyrzhikovskii, S. V., 1925. K VORPOSU OB AMILOLITICHESKOM DEISTVII SLIUNY DOMASHNIIKH ZHYVOTNYKH [Contribution to the question of the amylolytic action of saliva in domestic animals]. Fiziol. Zhurn. SSSR, 8 (5-6): 67-77.

The amylolytic action of saliva was studied in 15 horses, 10 cows, 5 sheep and 7 pigs; over 100 analyses made for each animal. Collection of the saliva was made under sterile conditions by the means of a swab introduced into the animal's

mouth, which had been thoroughly washed 15 to 20 min. earlier (Astashevskii's method). Conditioned stimuli were applied to elicit salivation; the saliva was then expressed and filtered. Preliminary tests with human saliva had shown that this method of collecting did not diminish the amylolytic action of the saliva. The sugar test was made using Trommer's reaction; the amylolytic power measured by the time needed for the reduction of 1 cc. of sizing by 1 cc. of saliva at 37°C. The glucose content of the saliva was determined by Galvialo's method.

A series of 8 tables gives the detailed results. The first positive Trommer was noted in the horse saliva after 8 h. 27 min., in the sheep after 2 h., and in the pig after 36 min. By taking the amylolytic power of horse saliva as the unit, the proportion becomes: horse 1.0, cow 2.8, sheep 4.2, pig 14.1, while that of human saliva is considerably higher. The amount of glucose in mg. found in the saliva after 2 h. shows an increase from the horse to the pig: horse 0.14, cow 0.38, sheep 0.75, pig 1.85, man 3.11. If the horse's salivary sugar content is taken as the unit, the proportions are: horse 1.0, cow 2.7, sheep 4.7, pig 13.0, man 22.2. Thus the amylolytic power of saliva in man is strong; in the pig, moderate; in the cow and sheep, weak; and in the horse, almost completely absent.

Comparative measurements in all the animals of the salivary components in percent and of the physical properties of the saliva are tabulated.

Vyvzhikhovskii, S. N., 1928. K VOPROSU O RABOTE PODCHELIUSTNOI I PODIĄZYCHNOI SLIUNNYKH ZHELEZ U KOZ [On the function of the submaxillary and sublingual glands in the goat]. Arkh. biol. Nauk, Leningrad, 28 (3): 257-269.

The submaxillary and sublingual secretion was studied in two fistulated goats. Salivary stimulants used were grass, hay, oats, flour, bran, hydrochloric acid (0.5%), acetic acid (5%), soda (10%), sand, gravel, oak bark, oak bark extract, dry lignum quassiae, milk, bread, powdered bran, as well as the smell or sight of food, and the rustling of hay. The amounts of foods were equivalent to 43.5 gm. of the dried substance. The feeding was done by three procedures: either all the food was given at once, in 4.5 minutes, or the animal was allowed to eat ad libitum for 5 minutes; each new substance was given 5 minutes after cessation of salivation.

Spontaneous submaxillary and sublingual secretion is not continuous, but shows many periods of rest. Tabulated results show that data given for dogs by Vulfson (1898), Zelgeim (1904), and Snarskii (1901) are equally applicable to goats. Different amounts of saliva are secreted in response to different stimulants, but for the same stimulant the rate on different days is approximately the same. However, in dogs the secretion in response to repellents is relatively greater than that to foods; in goats the secretions in response to equal quantities of foods or repellents are generally equal. Bitter substances as lignum quassiae, or its 10% extract, are not repellents for goats, and are taken readily. As in dogs, food stimulates a thicker saliva with a greater percentage of dry residue, than repellents, which elicit a thin saliva with

a very small amount of organic matter; this difference is much less accented in goats than in dogs.

The quality and quantity of the saliva secreted under the same circumstances, is very uniform from day to day. Comparing the results obtained by the three types of feeding, it is seen that artificial feeding (in 4.5 min.) elicits greater salivation than the food stimulation in itself. When a determined quantity of food is given at once, the time of feeding is decreased, the amount of salivary secretion decreasing almost proportionally. During ad libitum feeding for 5 minutes, where at least 1.5 times as much food is ingested than otherwise, salivation in response to grass, rusk and bran is almost the same as in the feeding during 4.5 minutes, in response to bread and hay it is greater, in response to oats, less than in the ad libitum feeding. Consequently, the manner of feeding and the time element in it have a great influence on the function of the salivary glands.

During rumination, the submaxillary gland shows variations in secretion from 0.1 to 0.5 cc. (average 1.2 cc.) in 5 minutes. The saliva during rumination is thicker than during feeding. The dry residue percentage average is 0.6 in food-stimulated saliva, and 0.70 to 0.85 in rumination saliva. The daily secretion rate from the mucous glands is about 200 cc., of which 10% pertain to rumination.

The amylolytic property of the submaxillary and sublingual saliva was examined by the Galvialo procedure: an average of 0.82 mg./cc. of sugar was found in the saliva during eating, and 0.96 mg./cc. during rumination. The viscosity measured 136 during eating, and 131 during rumination. Other physical properties were determined and are tabulated.

Wach, Edward C., 1933. SOME STUDIES ON CHEMICAL COMPOSITION OF HUMAN SALIVA. Jour. Dental Res., 13 (3): 183.

Advance abstract of the paper, Wach, 1936.

Wach, Edward, 1936. STUDIES ON THE POTASSIUM AND CALCIUM CONTENTS OF HUMAN SALIVA. Jour. dent. Res., 15 (5): 265-269.

The salivas of 30 patients (14 caries-susceptible, 5 with gingival erosion, 1 with acute ulcerative gingivitis and 10 caries-immune) were studied to determine any possible relationship between the ratio of K and Ca in saliva and immunity or susceptibility to dental caries.

An average of 15 cc. of mechanically stimulated saliva was obtained from each individual. Ca determinations were made by the Clark-Collip modification of the Kramer-Tisdall method; K, by the Kramer-Tisdall method.

When the Ca and K values of resting and paraffin-stimulated salivas of three individuals were compared, great variation was observed. The average K:Ca ratio was 10:1. In all cases, Ca was decreased and K increased by stimulation. Ca and K values did not appear to be related to caries immunity or susceptibility.

The salivary K content of actively carious cases (3) was slightly less than that of immune (4) and erosion (1) cases; in the erosion case, the Ca content was noticeably high.

The salivary K:Ca ratio varied markedly (4.5:1 to 25:1), while that of blood was fairly constant (1.4:1 to 3.25:1).

Variations in K are not caused by large variations in the mucin content of saliva, since only a small percentage of K occurred in combination with mucin.

Wach, E. C., J. F. O'Donnell, and M. K. Hine, 1942. EFFECTS OF A MOUTH RINSE ON ORAL ACID-GENIC BACTERIA. Jour. Amer. dent. Assoc., 29 (1): 61-66.

The effects of a quinone-urea solution (0.5% quinone hydrochloride, 4% urea C.P., and 25% glycerin in sterile distilled water, adjusted to a pH of 6.8 to 7.0 by NaOH) on oral acidogenic bacteria were studied *in vitro* and *in vivo*.

Two hundred tests were made in which 0.1 cc. quinone-urea solution was combined with 3 cc. unstimulated saliva and 0.4 cc. of 1% glucose, and incubated for 24 hours at 37°C.; pH and total titratable acidity readings, made after 2, 4, and 24 hours, indicated the inhibition of both acid formation and pH drop. In 200 additional tests, agar cultures were made at the end of the 4-hour incubation period. The quinone-urea mixture was effectively antibacterial in acid-dextrose broth (24 hr. incubation) and on tomato-agar plates (pH 5.0; 48 hr. incubation).

In *in vivo* tests, 18 persons used quinone-urea as a mouth rinse thrice daily for 14 days. At the end of that time, the total bacterial count was markedly reduced in each case. Simultaneously, the salivary pH rose and the titratable alkalinity fell approximately 50%.

Wach, E. C., R. G. Kesel, M. K. Hine, and J. F. O'Donnell, 1943. TESTING CARIES ACTIVITY BY ACID PRODUCTION IN SALIVA. Jour. dent. Res., 22 (5): 415-421.

A test for caries activity, based on the hydrogen ion concentration and total titratable acidity of unstimulated saliva, is described in full. When applied to the salivas of 50 patients (caries-free and having varying degrees of caries activity) in 818 tests, reliable indication of caries activity was obtained.

Wainwright, W. W., 1934. HUMAN SALIVA. II. A TECHNICAL PROCEDURE CALCIUM ANALYSIS. Jour. dental Res., 14 (6): 425-434. (Advance abstract: HUMAN SALIVA. II. TECHNICAL PROCEDURE FOR CALCIUM DETERMINATION. Jour. dent. Res., 14 (3): 171-172. 1934.)

A critical survey is presented of the various findings of 26 previous investigators on the calcium content of saliva. To establish a standard procedure for calcium determination, known amounts of Ca were added to saliva to test the reliability and effectiveness of the various methods. A modification of the methods of Halverson and Bergeim, and of Kirk and Schmidt, permitted the recovery of the known amounts of Ca. The method is described in detail.

Preliminary treatment entails deproteinization and centrifugation of saliva; the latter is recommended as a standard procedure, as the Ca values so obtained represent values closer to actually dissolved Ca and are not modified by Ca-containing debris. Other papers of this series under Becks (H.), 1934 m; 1938 m, n; 1939 m; 1941 m, n; 1942 m, n; 1944 n, 1946 m, n.

Wainwright, W. W., 1938. HUMAN SALIVA. V. A TECHNICAL PROCEDURE FOR PHOSPHORUS ANALYSIS. Jour. dent. Res., 17 (3): 235-250.

To ascertain the accuracy of several methods of phosphorus determination, four methods (Tisdall, Bell and Doisey, stannous chloride, and Fiske and Subbarow) were tested against solutions containing known quantities of phosphorus. All four proved to be satisfactorily accurate. When these methods were tested on seven saliva samples, the A. Bodansky modification of the stannous chloride method was the most satisfactory over the widest range of condition; it facilitated the use of the smallest saliva sample (0.1 cc., average), showed the best color development, and was found applicable over a range of inorganic phosphorus 0.0090 to 0.0560 mg.

The method recommended is as follows:

After centrifugation of the saliva and preparation of the trichloroacetic filtrate, "1. Transfer with an accurately calibrated pipette 0.2 cc. trichloroacetic filtrate to a pyrex 10 cc. volumetric flask. 2. To another pyrex 10 cc. volumetric flask add 2 cc. standard solution (equivalent of 0.02 mg. phosphorus). 3. To each of these flasks containing unknown and standard add water to 4 cc. in the flask. 4. Add 4 cc. molybdate reagent to each flask and mix. 5. Add 1 cc. dilute SnCl_2 , make to volume with water. 6. After a minute or more compare in colorimeter Calculation: the corrected tables and formulae of Bodansky are followed." A nomogram is presented for direct determination when the equivalent of 0.1 cc. of saliva is used.

"Reagents: (a) 10 per cent trichloroacetic acid (Merck). (b) Standard phosphate solution. Potassium acid phosphate (La Motte, buffer grade) prepared so that 2 cc. contain 0.02 mg. phosphorus. Preserved with a drop of toluene. (c) Molybdate reagent. Prepared fresh daily by mixing: 1 volume of cold 10N H_2SO_4 (300 cc. concentrated H_2SO_4 made to 1 liter), 1 volume 7.5 per cent molybdate stock solution added quickly while mixing, and finally 2 volumes of water. (The 7.5 per cent molybdate stock solution is prepared in a 2 liter flask from a solution containing 90 g. molybdic acid (Eimer and Amend, T.P., Special, "Ammonia- and phosphate-free") in 250 cc. of 5N NaOH. This is made to 2 liters and mixed. The solution should be faintly alkaline to phenolphthalein. Let stand and decant for use.) (d) Dilute stannous chloride. Sixty per cent solution of stannous chloride (Eimer and Amend, T. P.) in concentrated hydrochloric acid (stored in ice-box). Dilute 1 to 200 for use daily."

Wainwright, W. W., 1939. HUMAN SALIVA. VIII. A STUDY OF RATE OF FLOW OF ACTIVATED SALIVA. Jour. dent. Res., 18 (5): 441-446.

Day to day fluctuations in salivary flow were studied.

Samples of resting saliva were collected on 5 successive days from 20 individuals; the individuals were divided into two groups according to rate of flow -- Group I, a slow secreting group, and Group II, a rapidly secreting one. Samples of paraffin-stimulated saliva (450 chews) were than collected. The average rate of flow of stimulated saliva in Group I was 106.4 cc./hr.; in Group II, 173.8 cc./hr. Fluctuations were very large for both groups on the 5 successive

days; in Group I, from 9.0 to 78.5 cc./hr. (aver. 32.2) and in Group II, from 23.4 to 106.0 cc./hr. (aver. 48.2). These results indicate that the degree of fluctuation depends directly upon the magnitude of flow of resting saliva. When percentage fluctuations were calculated, the difference between the two groups (38% and 35%, respectively) was insignificant.

Fluctuations of activated (450 chews) saliva flow of 30 individuals were observed during 45 minutes of continuous collection. The average rate of flow in Group I was 84.0 cc./hr.; in Group II, 86.3 cc./hr. During 3,600 chews, individual differences in fluctuation were considerable; however, there was very little difference between Groups I and II as a whole, 43.4 cc./hr. (or 68.8%) and 42.5 cc./hr. (or 73.9%), respectively.

Fluctuations of flow of continuously activated saliva during 18 minutes of collection were 32.2 cc./hr. (47.5%) for Group I, and 28.6 cc./hr. (44.7%) for Group II. These values, although much smaller than those observed for the 45 minute period, were larger than those observed on the 5 consecutive days.

A comparison of these results with those of Brown and Klotz [cf. Brown, 1934m] is presented.

Wainwright, W. W., and Hermann Becks, 1939. HUMAN SALIVA. VI. METHODS OF BIOMETRICAL EVALUATION OF SALIVARY ANALYSES. *Jour. dent. Res.*, 18 (1): 1-41.

A review is presented of the fundamental work in biometrical methods, in particular as applied to salivary analyses. 61 refs.

Wainwright, W. W., 1943. HUMAN SALIVA. XV. INORGANIC PHOSPHORUS CONTENT OF RESTING SALIVA OF 650 HEALTHY INDIVIDUALS. *Jour. dent. Res.*, 22 (5): 403-414.

The inorganic phosphorus content of the resting salivas of 650 individuals (5 to 95 years) was determined. The average inorganic phosphorus value was 16.8 ± 0.25 (S.D. = 6.4 ± 18 mg./100 cc.) and the range from 6.1 to 71.0 mg./100 cc.

When 484 persons were selected and divided into 5-year age groups as before [cf. Becks, 1943], the arithmetic mean of phosphorus was 15.7 ± 0.24 mg./100 cc.; the S. D. = 5.4 ± 0.17 .

No significant differences were observed between the means of adjoining 5-year groups; when considered as larger groups, however, the difference between the mean of the 5 to 29 year group (14.19 ± 0.24 mg./100 cc.) and that of the 30 to 49 year olds (18.0 ± 0.57 mg./100 cc.) was significant. It is suggested that inorganic phosphorus values progressively increase after 49 years of age.

When the relation between phosphorus values and sex of the individual was studied, no significant difference was observed between the mean of the males (15.8 ± 0.37) and that of the females (15.7 ± 0.23). Differences between males and females in the five year and in larger groups were similarly insignificant.

When inorganic phosphorus secretion was tabulated in mg./hr., the average secretion rate was 3.06 ± 0.07 (S. D. = 1.89 ± 0.05 mg./hr.). The individual values ranged from 0.21 to 16.72 mg./hr. No relationship to age was indicated. The average mg./hr. value of 484 individuals between the ages of 5 and 49 was 2.94 ± 0.09 ; the S. D. = 1.90 ± 0.06 mg./hr.

The mean calcium secretion, when correlated with the age of the individual, increased progressively up to 29 years; however, the only significant difference was that between the 5 to 9 year group and the 10 to 14 year group. The mean of the eliminated group of individuals (from 50 to 95 years of age), 3.42 ± 0.16 , S. D. = 2.02 ± 11.0 mg./hr., was significantly different from the 5 to 49 year group. When correlated with the sex of the individual, the average for the males (3.21 ± 0.11 mg./hr.) was slightly higher than that for the females (2.78 ± 0.12), but the author considers the difference questionable.

A summary of this paper (XV) and of two previous papers (XIII and XIV) is presented.

Wainwright, W. W., and Hermann Becks, 1944. HUMAN SALIVA. XVII. IS THERE A SEASONAL INFLUENCE ON RATE OF FLOW AND CALCIUM AND PHOSPHORUS CONTENT OF RESTING SALIVA? *Jour. dent. Res.*, 23 (3): 220.

In the analysis of the saliva of 650 individuals over a period of 3 years, no seasonal variation could be found in the rate of flow or in the calcium or phosphorus content of the saliva.

Wainwright, W. W., and H. Becks, 1946. HUMAN SALIVA. XVIII. IS THERE A SEASONAL INFLUENCE ON RATE OF FLOW AND CALCIUM AND PHOSPHORUS CONTENT OF RESTING SALIVA? *Jour. dent. Res.*, 25 (4): 285-291.

The resting salivas of 650 healthy individuals were studied for seasonal variation or rate of flow and calcium and phosphorus contents over a 3-year period. In contrast to the work of Brawley and Sedwick [cf. Brawley, 1938], in which a seasonal variation of the calcium content among individuals was observed, the author found no seasonal influence on calcium nor on phosphorus contents or rate of flow.

Walawski, Juljan, 1936. RECHERCHES EXPERIMENTALES SUR L'ACTION HYPOTENSIVE DE LA SALIVE [Experimental investigations on the hypotensive action of saliva]. *Medycyna doświadczalna i społeczna, Warszawa*, 21 (5-6): 319-366.

The hypotensive effect produced by injection of saliva on blood pressure was studied in 190 experiments in the dog. Results showed that intravenous injection of 10 to 22 cc./kg. amounts of any type of saliva lowered the blood pressure. Duration of the effect was dependent upon the amount of saliva injected, but the degree of pressure drop was not related to the secretion rate of the injected saliva, hence, not to the amount of salivary chlorides, pH, or enzymes which vary with the secretion rate. The hypotensive effect is considered to be of organic origin, as brief boiling of the saliva decreased this effect while it was absent after injections of either saliva boiled 4 to 5 minutes or dissolved salivary ash. Injections of atropine, ergotamine, or physostigmine did not affect the hypotensive reaction to injected saliva. Saliva produced a negative inotropism on the isolated frog or rabbit heart, inducing a coronary vasoconstriction and an increase in cardiac diastole which appears on the EKG curve as an increase in length. The injection of saliva did not elicit the secretion of digestive juices. The hypotensive substances of saliva are probably absorbed in the intestine, inducing a slow decrease in blood pressure. Blood esterase does not destroy the salivary hypotensive substances, even after prolonged contact. The role of saliva consists mainly in

supplying the hypotensive substance to the digestive tract in order to assure a better blood circulation and thus contribute to a more active functioning of the digestive gland. [From author's abstract].

Walawski, Julien, 1936. RECHERCHES EXPERIMENTALES SUR L'ACTION HYPOTENSIVE DE LA SALIVE [Experimental study of the hypotensive action of saliva]. *Compt. rend Soc. biol. (Paris)*, 123: 29-31.

Submaxillary or parotid saliva of the dog, stimulated by application of acetic acid to the buccal mucosa, was used in 190 experiments to study the hypotensive activity of such saliva, in the decerebrated dog. Human saliva was also used in these experiments. The saliva was treated in various ways (non-filtered or filtered to remove albumin, the residue diluted with water, boiled, ashed, mixed with citrated or defibrinated blood and then incubated at 38°C for 25 minutes). Prior to intravenous injection of the saliva in doses varying from 0.2 to 0.5 cc./kg., the dogs were administered atropine, ergotamine, physostigmine, or histamine.

Results showed that carotid blood pressure dropped on injection of filtered or unfiltered saliva (submaxillary, parotid, or both). No marked difference in activity was noted in the salivas from different glands; human saliva was more active than canine. The amount and duration of pressure drop was proportional to the amount of saliva injected. As the degree of pressure drop was independent of the rate at which the saliva was secreted, the hypotensive activity was not related to the amount of chlorides present to salivary pH nor to salivary enzymes. The principle is considered to be of organic origin as activity of the saliva is removed by boiling for 4 to 5 minutes. Salivary ash dissolved in water had no effect on blood pressure. Atropine, ergotamine, and physostigmine had no effect on the blood pressure after injection of the saliva which produces vasodilation. The saliva produced a negative inotropism on the isolated heart of the frog and the rabbit, a vasoconstriction of the coronaries as well as an augmented diastole of the heart. The saliva did not stimulate secretion of digestive fluids under experimental conditions. The hypotensive substances of the saliva were not destroyed by esterase of the blood even after prolonged contact.

Walker, Florence, and Lillian Sheppard, 1935. A STUDY OF THE VARIATION IN THE SACCHAROGENIC POWER OF HUMAN SALIVA. *Amer. Jour. Physiol.*, 111 (1): 192-195.

The saccharogenic power, the rate of secretion, and the total solids content of the saliva of 5 individuals fed a normal mixed diet without tea or coffee were determined. Saliva was collected with as little motion of the jaws as possible and was discharged into a weighing bottle surrounded by ice. After the sample was weighed, it was immediately filtered and kept surrounded by ice until needed.

Saliva was diluted with 24 parts of redistilled water. The saccharogenic power of the saliva was determined by allowing 1 cc. of diluted saliva to act for 1/2 hour at 40° on 100 cc. of 1% dispersion of soluble starch to which had been added 5 cc. of 1M NaCl and 2.5 cc. of 0.02M disodium

hydrogen phosphate. The pH of the substrate was adjusted to 6.4. At the end of 1/2 hour the action of the enzyme was stopped by the addition of 50 cc. of Fehling's solution. The mixture was immersed in a boiling water bath for 15 min. and the weight of cuprous oxide formed by the reducing sugar was taken as a measure of the saccharogenic power of the saliva.

In 17 experiments performed on the 5 individuals the average increase in saccharogenic power 1/2 hour after breakfast was 77%. Appreciable increases in the rate of secretion and total solids content of the saliva were observed.

The saliva collected after lunch was likewise more active than that collected before lunch, with an average increase of 27%. Similar increases in the rate of flow were found, but variations in total solids content were irregular.

After dinner an average increase of 11% was observed with small increases in both rate of secretion and solids content.

The lowest value for the 12-hour day was recorded before breakfast and the highest after dinner. The variation in the rate of secretion followed the same general trend as does the variation in saccharogenic power.

The ingestion of coffee with breakfast did not diminish the activity of saliva collected after breakfast.

Walker, Hilda, 1925. THE INFLUENCE OF DIFFERENT SUBSTANCES ON THE DIASTATIC ACTIVITY OF SALIVA. *Biochem. Jour.*, 19 (2): 221-225.

Using Wohlemuth's method for the estimation of diastatic activity and a set of standards to determine the achromic point, the action of sweet substances on the activity and secretion of ptyalin were observed. Data indicates that the amount of digestion increases with increased salivation. Cane sugar and maltose (in the mouth) were found to enhance salivation, but maltose, lactose, or fructose depress the salivary digestion ability. Cane sugar, the sodium salt of saccharin and lactose in solution promote ptyalin activity; glycerol retards this activity. Galactose was found to have no apparent effect.

Wallace, J. S., 1921. THE PHYSIOLOGY OF ORAL HYGIENE. *Lancet.*, 201 (7): 339.

Saliva is more important as a factor in oral hygiene than it is as a digestive juice. The mucous in the saliva is effective in protecting and cleansing the teeth.

Wang, S. C., 1943. LOCALIZATION OF THE SALIVARY CENTER IN THE MEDULLA OF THE CAT. *Jour. Neurophysiol.*, 6 (3): 195-201.

Experiments on the lower brain stem of 35 cats were made in an effort to determine the precise anatomical location of the salivation center. The Horsley-Clarke stereotaxic instrument was employed; the procedure is described in detail. In general, findings indicated that stimulation of the medulla with a weak current elicited a copious flow of saliva from the homolateral glands. When a more specific localization was attempted, saliva secretion was evoked by stimulation of the solitary fasciculus and its nucleus, or portions of the spinal trigeminal nucleus and tract (afferent system), and it was indicated that the "salivary nuclear masses might be either in the medial position caudal to the

facial genu, or more likely, in the dorso-lateral region of the lateral reticular formation, dorso-medial to the spinal trigeminal nucleus, and dorsal to and at the level of the facial nucleus" (efferent system). The centers are not sharply divided for the nerve fibers of the 7th and 9th cranial nerves. The rostral portion of the medulla (the area medial and dorsal to the spinal trigeminal nucleus and tract) supplies the submaxillary gland, while the caudal area (at the level of the facial nucleus and the superior olive) supplies the parotid. Stimulation of portions of the homolateral medulla elicited secretion from both submaxillary and parotid glands.

A diagrammatic representation of the results is presented (cf. p. 197).

A small injection of atropine (0.1 mg.) inhibited salivary flow produced by medullary stimulation swiftly and completely. Sectioning of the chorda tympani before its juncture with the lingual nerve had a similar effect.

Ward, Robert, and B. Walters, 1947. THE ELIMINATION OF POLIOMYELITIS VIRUS FROM THE HUMAN MOUTH OR NOSE. *Johns Hopkins Hosp. Bull.*, 80 (1): 98-106.

A study was made of 19 patients in early stages of poliomyelitis. The patient talked, blew, coughed, or expectorated into a sterile cloth mask for one-half hour. Extraction of the human virus from the masks was then attempted. Three of the *Macaca mulatta* monkeys inoculated with extracts made from the masks showed positive clinical and pathological evidence of poliomyelitis. The epidemiological significance of the results is discussed.

Warfield, Louis M., 1911. A PEPTID-SPLITTING FERMENT IN THE SALIVA. *Johns Hopkins Hosp. Bull.*, 22 (242): 150-152.

The presence of a substance in saliva, probably an enzyme, which is capable of splitting glycyltryptophan, is reported. The substance was found only in alkaline saliva and was destroyed by heating to 100°C.

Wase, Arthur W., and Y. S. L. Feng, 1956. EFFECT OF SIALADENECTOMY OF THYROID ACTIVITY. *Nature*, 177 (4509): 624-625.

Preliminary observations are reported on the effects of removal of submaxillary, parotid, and sublingual salivary glands in adult male mice. Experimental groups were composed of 10 to 12 mice, weighing 25 ± 1 gm., whose glands had been removed 10 days previously; sham-operated controls were employed throughout.

Administration of radioactive iodine (5 μ c. of $I^{131}/25$ gm. body wt.) showed the desalivated mice to have an increased iodine uptake in the first four hours after the injection, possibly reflecting a lack of salivary transport of iodine in the operated animals. Uptake was maximal 6 to 8 hours after injection. The 24-hour thyroid iodine levels were always lower in the test mice than in the sham-operated mice, with I^{131} disappearing slowly or not at all during the 24-48 hr. period, indicating a subnormal thyroid metabolism.

Injection of 50 μ c. of radioactive phosphate to measure the titre of thyroid-stimulating hormone in the experimental animals showed the uptake of P^{32} to be 30 to 38% lower than that of the controls. Intraperitoneal injection of 5 μ g. of

thyroid-stimulating hormone restored the P^{32} activity of the thyroid in the desalivated mice to normal levels. Administration of single such doses of the hormone caused an 84% gain in P^{32} uptake in the experimental animals, and only an 18% gain over the base rate in the controls. The increased hormone sensitivity of the desalivated mice indicates impairment of a thyroid-regulation mechanism, the salivary glands affecting thyroid activity possibly by means of a hormone or enzyme present in the salivary glands.

Watanabe, Yoshio, 1951. THE EFFECT OF ROENTGEN IRRADIATION UPON THE CELLULAR ELEMENTS IN THE HUMAN SALIVA. *Oral Surg.*, 4 (1): 89-107.

Nine experiments of a single exposure of 50 r., 100 r., or 200 r. irradiation on the right cheek were made on five healthy normal adult males in order to examine the roentgen effect on salivary corpuscles by means of a disintegration grade and to find the relation of salivary corpuscles to leucocytes in the blood. Smears of unstimulated saliva, stained by Giemsa's stain, were examined with the oil immersion lens. The cells were differentiated in epithelial cells and salivary corpuscles, and classified according to their disintegration grade. The white blood cell count and nuclear mean estimation were made simultaneously with the examination of the saliva.

The salivary cell count showed an increase just after 100 r. or 200 r. irradiation, and in the sialogram the per cent of salivary corpuscles showed a rising tendency. In 50 r. irradiation the disintegration mean (DM) rose and the nuclear mean (NM) fell for 3 hours, both returning to normal fluctuation thereafter. In 100 r. irradiation the D. M. rose and the N. M. fell only on the day of irradiation, both returning to normal on the next day. In 200 r. irradiation the D. M. gradually rose to a peak after one day and the N. M. fell to a maximum after 3 hours. They gradually returned to normal after 6 days.

No relationship of salivary corpuscles to leucocytes in the blood could be found.

Watrin, J., and P. Florentin, 1927. MODIFICATIONS DES GLANDES SALIVAIRES DU COBAYE SOUS L'INFLUENCE DES RAYONS X [Changes in the salivary glands of the guinea pig under the influence of X-rays]. *Compt. rend. de la Soc. de Biol. (Paris)*, 97 (30): 1297-1298.

The submaxillary glands of 10 guinea pigs were subjected to X-ray radiation of 1500-2000 r. Examination of the glandular tissue 10 days later showed no changes in the form or structure of the acini. Marked changes were noted, however, in the secretory ducts marked by a hyperplasia of cellular elements and an increase in number and volume of secretory canals.

Waugh, D. B. and L. M. Waugh, 1940. EFFECTS OF NATURAL AND REFINED SUGARS ON ORAL LACTOBACILLI AND CARIES AMONG PRIMITIVE ESKIMOS. *Amer. Jour. Dis. Child.*, 59 (3): 483-489.

A bacteriological study was made of the saliva of 45 Kuskokwim Eskimos before and after a 5 to 13 week diet containing either natural or refined sugars. In the group fed natural sugars a 2% drop was noted in the number of those who showed the presence of lactobacilli at the beginning of the test. In the group fed refined sugars those showing the organism increased from an initial 18% to 100% of the subjects.

Waugh, L. M., 1910. INVESTIGATIONS ON PLAQUE FORMATION AND DENTAL CARIES IN RELATION TO SALIVA. Dental Cosmos, 52 (2): 170-175.

A culture broth was prepared by crushing and kneading fresh meat in spring water containing considerable dissolved calcium carbonate, then straining and sterilizing the broth. A portion of this broth was infected with 5 cc. of saliva containing a small quantity of decaying substance from a carious molar, and the suspension incubated for 48 hours. This suspension, found to contain a variety of microorganisms, was used to seed 116 tubes containing the prepared broth, which were incubated for 48 hours. Fifty-one of these tubes were treated with carbolic acid. Potassium thiocyanate (KCNS) was added to 26 of these tubes, none of which developed plaques after 14 days of incubation. In 10 of the remaining 25 tubes without KCNS, a plaque developed which adhered tenaciously to the side of each tube. Of 44 tubes treated with a cassis emulsion, 24 also contained KCNS, 3 of which developed plaques, while 7 of the 20 without KCNS developed plaques. Only 1 of the remaining 10, unmedicated, tubes developed a plaque; the causative factor was not determined. The incidence of plaque formation was lower in the tubes containing KCNS, and the plaques were smaller and less vigorous than they were in those which lacked potassium thiocyanate.

Weber, T. B., V. J. Lux, and R. H. Englander, 1958. DETERMINATION OF METALLIC ELEMENTS IN PAROTID SECRETION. Jour. dent. Res., 37 (1): 28.

Collections of parotid secretion from 43 caries-rampant males, aged 17 to 21 years, were made from the right Stenson's duct by means of a parotid cup. The parotid was stimulated by having each patient chew gum for 5 minutes. Aliquots of each sample or of pooled samples were analyzed with a DU flame spectrophotometer. All metallic elements reported as occurring in human fluids or tissues were studied except those in which it was not possible to eliminate interferences or in which the ultimate limit of detection was beyond the range of the instrument. Of those listed as occurring in relatively high concentration in fluids and tissues the following were studied: Fe, Cu, Mn, Co, Ni, Cr, Sn, Ti, Rb, Li, B, Ba, and Sr. Ag and V were tested among those listed as rarely present. The following values were found for the major metals: Ca 4.5 (S.D. ± 1.4), Mg 5.7 (S.D. ± 3.3), Na 48.4 (S.D. ± 31.6), and K 58.6 (S.D. 24.5) mg. per cent. (Author's abstract)

Weigmann, F., and A. Koehn, 1936. WEITERE UNTERSUCHUNGEN ÜBER DIE WIRKUNG DES MENSCHLICHEN SPEICHEL AUF DIPHThERIEBACILLEN. I. DIE ENTWICKLUNGSHEMMENDE BIS KEIMTOTENDE WIRKUNG DES SPEICHEL AUF DIE DIPHThERIEBACILLENTYPEN [Further investigations on the action of human saliva on diphtheria bacilli. I. The bacteriostatic to bactericidal action of saliva on the diphtheria bacilli types]. Zeitschr. f. Hyg. u. Infektionskrankh., 118 (5): 507-515.

Three strains of *Bacillus diphtheriae gravis* were exposed to saliva of five persons. Inhibition was noticeable in 18-40 hours in four of the five. The saliva of the fifth person showed no inhibitory effect.

The inhibitory action varied from person to person (as seen above), and variations from strong action to complete absence of inhibition were

noted in the same person at different times. There was a period when samples taken from test persons showed no inhibition, while previous saliva samples of the same persons had been strongly bacteriostatic. This could be attributable to the fact that several test persons had contracted colds.

The antibacterial action of human saliva was inactivated by heating at 56°C. for 30 minutes. Filtration at 2 atm. pressure of an inert gas, such as nitrogen, depressed the action but, in the case of strongly active saliva, did not completely neutralize it.

The different types of diphtheria bacilli exhibited different resistances to salivary action. (cf. Weigmann et al, 1937.)

Weigmann, F., and A. Koehn, 1936. WEITERE UNTERSUCHUNGEN ÜBER DIE WIRKUNG DES MENSCHLICHEN SPEICHEL AUF DIPHThERIEBACILLEN. II. DIE UMWANDLUNG DER DIPHThERIEBACILLENTYPEN UNTER DER EINWIRKUNG DES MENSCHLICHEN SPEICHEL [Further investigations on the action of human saliva on diphtheria bacilli. II. The transformation of diphtheria bacilli under the influence of human saliva]. Zeitschr. f. Hyg. u. Infektionskrankh., 118 (5): 516-532.

A series of experiments were conducted on the ability of saliva to transform diphtheria into pseudo-diphtheria bacilli. Single cultures of three types of *Corynebacterium diphtheriae* (*gravis*, *mitis*, and *intermedius*), exposed to fresh, filtered saliva, were transformed into pseudo-diphtheria bacilli similar in all cultural properties to those of the Hoffman type [*Corynebacterium pseudodiphtheriticum*]. C. *Diphtheriae* types *intermedius* and *mitis* were directly transformed into pseudo-diphtheria forms, while the *gravis* type developed a transitional form similar in every way to the *intermedius* type. From the foregoing, the authors conclude that the *intermedius* type does not constitute a separate type but is merely a modified form of *gravis*.

Subcultures of the pseudo-diphtheria bacilli after six months' laboratory preservation showed no regression to the original forms but maintained constant characteristics.

Weigmann, F., and H. Noeske, 1937. UNTERSUCHUNGEN ÜBER DEN ANTIBAKTERIELL WIRKSAMEN FAKTOR IM MENSCHLICHEN SPEICHEL [Investigations on the antibacterially active factor in human saliva]. Zeitschr. f. Hyg. u. Infektionskrankh., 119 (4): 413-424.

Elaborating on the work of previous authors (Dold et al, 1934; Weigmann et al, 1936), experiments were made using a larger number of test persons, as well as a greater variety of pathogenic and non-pathogenic bacteria.

The inhibitory action of the saliva of 11 persons was tested on 3 types of diphtheria bacteria, pseudodiphtheria bacteria, *Bacillus anthracis*, *B. subtilis*, *B. coli*, *B. proteus*, *B. prodigiosus*, *Staphylococcus aureus*, *Micrococcus tetragenes*, and several pneumococci and streptococci. The action varied among salivas and there were fluctuations in the anti-bacterial action in the same person at different times.

The inhibitory action was removed by heating the saliva at 56°C. for 30 min., by filtration through an asbestos filter, or by storage for 5 to 10 days.

Mouth bacteria added to test cultures depressed the growth of test bacteria only moderately.

Fresh saliva, incubated after addition of a piece of copper (to prevent decomposition) at 37°C. for 24-96 hours, lost most of its bacterial content, but retained its bactericidal effect. From these observations, the authors conclude that the bacteriostatic action of the saliva is not solely dependent on the antagonistic effect of mouth bacteria. They assume that the action is due to the presence of protein-like, thermolabile substances (Dold's inhibines).

Weigmann, F., and H. Hölzl, 1940. UNTERSUCHUNGEN ÜBER DIE ANTAGONISTISCHE WIRKUNG VON STREPTOKOKKEN GEGENÜBER DIPHTHERIE- UND ANDER BAKTERIEN [Investigations on the antagonistic action of streptococci on diphtheria and other bacilli]. Zeitschr. f. Hyg. u. Infektionskrankh., 122 (6): 673-683.

Investigations were made on the antagonistic action of streptococci on a virulent strain of diphtheria bacilli, a strain of Staphylococcus pyogenes aureus, and a laboratory strain of B. subtilis.

Thirty-six strains of streptococci were grown on pour-plates. Their growth on agar was generally good; their bacteriostatic action on the test bacteria varied, being strongest against diphtheria bacilli and weakest against B. subtilis.

In comparing the origins of the streptococci, it appeared that the strongly bactericidal strains originated from tonsillar swabbings, a few from mastoiditis, and the weaker strains from other sources.

It was assumed that the antagonism could be caused by simple overrunning, withdrawal of nutrient or the production of bacteriostatic metabolic products. In testing the validity of this assumption, strains were chosen which previously had proven to be good bactericidal agents, and were cultured in bouillon. All bactericidal properties were lost within 8 days. Two strains retained their properties for the longest time. These were cultured in bouillon for two days. When heated at 56° for 20 minutes, all bactericidal properties disappeared, and the three test materials grew in the medium as well as they had on the sterile control plates. Streptococcal cultures centrifuged for 15 minutes at 3500 revolutions, lost most, but not all bacteria and retained some bacterial action. The filtrate of bouillon cultures was germ free and lacked all bactericidal power. The results were not conclusive as to the mechanism of antagonism.

The saliva of four persons was spread onto blood plates and, after 24 hours, pure cultures of streptococci were prepared and bouillon tubules inoculated. Drops of the 2-day bouillon culture were placed on ascites-agar plates, on which diphtheria bacillus had been evenly spread. Wide inhibition areas around the bouillon drops were evidence of the remarkably strong bactericidal action of the mouth streptococci on diphtheria bacilli.

Similar experiments were performed by culturing bacteria on a cellophane membrane which was placed over the diphtheria-inoculated ascites-agar plates. After 24 hours of incubation, there was no growth in the areas of the streptococcal drops. When the membrane and streptococci were removed and the plates incubated, the inhibitory areas were even more accentuated.

The results of these experiments indicate that the antagonistic action of streptococci is due to their metabolic products.

One might be inclined to assume that streptococcal activity is the cause of inhibitory effects of saliva. The streptococci are, however, much fewer in the mouth cavity than in a bouillon or agar culture and can, in such numbers, not display any bacteriostatic action. The streptococcal antagonism can likewise be suppressed by other bacteria present.

Weinmann, Josef, 1934. PROTEOLYTIC FERMENTS IN SALIVA. Jour. dental Res., 14 (3): 205.

"To determine presence of proteolytic ferments, we used fibrin as indicator, comparing quantity of dissolved fibrin with that undissolved. With this qualitative method, we found that much fibrin was digested in saliva. An autolyzing ferment was also found by comparing the quantities of residual nitrogen in saliva, and in portions of it allowed to stand for a day at 37°C. The quantity in the latter was much greater than that in the former, showing that salivary protein was dissolved. It is probable that these findings have some relation to oral diseases. [The author's precautions to exclude the action of bacteria were not stated.--Ed.]."

Weinmann, Josef, 1935. AUTOPROTEOLYSIS OF HUMAN SALIVA. Jour. Dental Res., 15 (3-4): 202-203.

Continuation of previous studies (Weinmann, 1934) shows that only a slight alteration of pH occurs during autoproteolysis. Protease in fresh saliva is derived from migratory cells from oral mucous membranes, not from bacteria. The quantity of salivary protease varies greatly, but keeps within certain limits for any individual. (Author's abstract)

Weinmann, Josef, 1936. RÔLE OF LEUCOCYTES IN SALIVA. Jour. dental Res., 15 (5): 360.

Caries-immunity appears to be related to the action of salivary leucocytes ("salivary corpuscles") migrating through the mucous membrane (chiefly the gingivae). These leucocytes produce proteases and give oxidase reactions. The average percentage amounts of proteolytic enzymes are much higher in the caries-immune mouths than in caries-susceptible individuals. The saliva of the immune is capable of stopping the growth of or killing bacteria foreign to the mouth (i.e. the saliva of the caries-immune individuals stopped the growth of 70% of Bacillus prodigiosus introduced); that of the caries-susceptibles is 50% weaker. However, no difference in counts of the leucocytes occurred between the two groups. In the mouths of the caries-immune persons equal numbers of leucocytes produce more proteolytic enzymes than in the susceptibles.

Weisberger, David, 1946. WHOLE SALIVA AS A SOURCE OF CERTAIN GROWTH FACTORS FOR AN ORAL STRAIN OF LACTOBACILLUS. Jour. dental Res., 25 (2): 83-87.

In a previous paper [Weisberger, D., and F. G. Johnson. Jour. dental Res., 25: 35. 1946.], Lactobacillus acidophilus (strain 333) was isolated from human saliva and exhibited maximum growth and acid production on a synthetic medium composed of casein hydrolysate, tryptophane, mono- and dipotassium phosphates, thiamin hydrochloride, nicotinic acid, calcium pantothenate, and dextrose.

In the present study, the organism was grown in whole saliva or in concentrated (up to seven-fold) saliva. The saliva replaced some of the constituents of the synthetic medium (*i.e.*, potassium phosphate), but not others (*i.e.*, the amino acids and other forms of nitrogen provided by the casein hydrolysate and tryptophane of the synthetic medium).

Weisberger, David, 1946a. HYDROLYZED SALIVA AS A SOURCE OF NUTRIENTS ESSENTIAL FOR THE PRODUCTION OF ACID BY AN ORAL STRAIN OF *LACTOBACILLUS ACIDOPHILUS*. Jour. dental Res., 25 (3): 137-144.

A previous study [cf. Weisberger, 1946], had indicated that whole saliva could not be substituted for casein hydrolysate or tryptophane of the synthetic medium effecting optimum growth and acid production of the organism. It is shown in the present paper that when whole saliva was hydrolyzed (by acid or alkali), it could successfully be substituted for both compounds, and was suitable as a nutrient for the lactobacillus.

Weisberger, David, 1946b. SALIVA INCUBATED WITH GLUCOSE AS A REPLACEMENT FOR TRYPTOPHANE IN A SYNTHETIC MEDIUM SUPPORTING THE PRODUCTION OF ACID BY *LACTOBACILLUS ACIDOPHILUS*. Jour. dental Res., 25 (6): 487-490.

"1. Human saliva incubated with glucose at 37.5°C. for 24 or more hours may be substituted for the added tryptophane in a synthetic medium which promotes the production of acid by *Lactobacillus acidophilus*.

"2. Saliva incubated without added glucose caused only a minimal increase in the production of acid.

"3. When saliva incubated with glucose was substituted for casein hydrolysate in the synthetic medium acid production occurred but the quantity was only about one-fifth that obtained in the presence of the casein hydrolysate." (Author's summary.)

Weisberger, David, 1946c. CHANGES IN "CARBOXYL-CO₂" AND OF AMMONIA PLUS-UREA NITROGEN IN SALIVA INCUBATED WITH GLUCOSE. Jour. dental Res., 25 (6): 491-495.

"1. The quantity of CO₂ liberated from human incubated saliva by the action of ninhydrin (designated as 'carboxyl-CO₂') is increased approximately 100% when glucose is added.

"2. The increase in 'carboxyl-CO₂' provides evidence of a chemical nature for the liberation of additional amino acids in saliva maintained in contact with glucose at body temperature. This finding points toward free amino acids as the constituents of saliva incubated with glucose which enable saliva so treated to act as a substitute for tryptophane and to a lesser extent for other amino acids of a synthetic bacteriological medium.

"3. The quantity of ammonia-plus-urea nitrogen increased from 200-400% when human saliva was incubated by itself for 24-192 hours. When glucose was added to the saliva the increases of ammonia-plus-urea nitrogen observed were only in the order of about 15%. In each circumstance the increase was almost entirely in the ammonia fraction. The results are interpreted as evidence that the presence of glucose in saliva favors the process of proteolysis over that of deamination." (Author's summary.)

Weinstein, J. W., 1911. THE TRYPTOPHAN TEST FOR CANCER OF THE STOMACH WITH SPECIAL REFERENCE TO PEPTIDOLYTIC ENZYME IN THE SALIVA. Jour. Amer. med. Assoc., 57 (18): 1420-1424.

The dependability of the tryptophan test (the presence of tryptophan in the gastric secretion taken as an indication of stomach (cancer) is studied. In confirmation of Warfield's (1911) work, 7 of 8 salivas, tested by simple combination with glycyltryptophan, induced the production of tryptophan indicating that the swallowed saliva may be responsible for the tryptophan. The author defends, however, the efficiency of his test by asserting that in all his studies the salivary protease failed to produce tryptophan in non-cancerous gastric contents.

Weisenstein, P. R., and G. E. Green, 1957. CLINICAL AND BACTERIOLOGIC STUDIES OF CARIES-IMMUNE HUMAN BEINGS. Jour. dent. Res., 36 (5): 690-694.

Study of 89 caries-immune subjects over a 3-year period included dental examinations at least once a year and salivary lactobacillus counts 2 to 3 times per year. Zero or low lactobacillus counts were common; lactobacilli present were usually of the smooth colony type. Five of the subjects who developed dental caries while under observation showed repeated counts exceeding 5000/ml. saliva and the presence of rough colony lactobacilli.

Weisman, Abner I., and Charles C. Yerbury, 1936. AN INVESTIGATION OF THE HORMONE CONTENT OF SALIVA. Endocrinology, 20 (1): 103-104.

When the salivas of 8 individuals (1 male and 7 females, including 5 pregnant) were tested for hormone content by the Ascheim-Zondek and vaginal smear methods, there was no indication of the presence of an anterior pituitary-like hormone or estrus-producing hormone.

Weisman, Abner I., 1936. FURTHER INVESTIGATION OF THE HORMONE CONTENT OF SALIVA USING THE FEMALE BITTERLING TEST. Endocrinology, 20 (6): 864-865.

Female bitterlings, used as a test for the presence of male hormones, displayed no reaction to salivary samples from 10 normal males, 10 normal females, and 15 pregnant women. It is concluded that no male hormone existed in any of the salivary samples tested.

Wenger, M. A., 1942. A STUDY OF PHYSIOLOGICAL FACTORS: THE AUTONOMIC NERVOUS SYSTEM AND THE SKELETAL MUSCULATURE. Human Biol., 14 (1): 69-84.

An investigation of 62 children (6 to 11 years of age) was made of the salivary volume and percent of solids as well as other physiological functions innervated by the parasympathetic and sympathetic nervous systems, and of the correlated distributions of some of these functions, to study underlying stimulation-response complexes.

Werle, E., and P. von Roden, 1936. ÜBER DES VORKOMMEN VON KALLIKREIN IN DEN SPEICHELDRÜSEN UND IM MUNDSPESICHEL [On the occurrence of kallikrein in the salivary glands and in saliva]. Biochem. Zeitschr., 286 (3-4): 213-219.

In studying the possible identity of pancreatic kallikrein and of an active factor in the extracts of various glands and in saliva, the author observed the following similarities:

Intravenous injections of either produced a lowering of blood pressure, enlargement of heart, and pulse acceleration.

Boiling completely destroyed the activity in a short time, as did treatment with normal HCl or normal NaOH at 37°C.

Inactivation of the dialyzed saliva or of dialyzed glandular extracts occurred after mixing with blood serum or with inactivator from bovine parotid glands. This inactivation is, as that of kallikrein, reversible.

Like kallikrein, the active substance of saliva and of gland extracts is destroyed by ultraviolet light and, to a lesser degree, by H₂O₂ and iodine. In cat and dog, the relative activity of kallikrein and of the active substances of saliva and extracts remains constant.

The active substance of extracts and of saliva was, like kallikrein, insoluble in 50% acetone and was (by means of acetone precipitation) partially cleared of impurities, increasing the activity of the substance. The amount of saliva preparation required to yield the effect of 1 unit of kallikrein was reduced from 1.93 mg. to 0.41 mg.; in the submaxillary preparation from the pig, 1 kallikrein unit was obtained from 400 γ compared to 840 γ required before purification.

The author reaches the conclusion that the substances are identical.

The significance of the presence of kallikrein in saliva is not quite understood. It is questioned whether kallikrein is participating in the fermentative or mechanical process of digestion or of the resorption in the digestive tract.

After extirpation of the pancreas in the dog, the kallikrein concentration in the urine decreased by 20 to 40% of the original value, the concentration returning almost to normal when the dog was treated with insulin. It is probable that the salivary glands are the source of kallikrein after pancreas extirpation.

Two tables showing the kallikrein values obtained for the salivary glands of man, pig, dog, bovine cattle, and horse are given. The average kallikrein concentration of the sublingual gland ranged from 0.0 in the horse to 1.43 kallikrein units per gram in man, that of the submaxillary gland from 0.0 in the horse to 27 in the pig, that of the parotid from 0.0 in the pig, horse, and bovine cattle to 1.86 in dog, and that of the pancreas ranged from 0.5 in the horse to 15.0 in pig and dog. In man, the values were 1.43 (sublingual gland), 1.73 (submaxillary gland), 0.38 (parotid gland), and 4.0 (pancreas) units per 1 g. gland.

Werle, E., and P. Roden, 1939. ÜBER DAS VORKOMMEN VON KALLIKREIN IN DEN SPEICHELDRÜSEN UND IM MUNDSPICHEL UND ÜBER EINE BLUTDRUCK-STEIGERENDE SUBSTANZ IN DER SUBMAXILLARISDRÜSE DES HUNDES [On the occurrence of kallikrein in the salivary gland and in the saliva, and about a blood pressure-raising substance in the submaxillary gland of the dog]. *Biochem. Zeitschr.*, 301 (5-6): 328-337.

Endocrine substances found in the saliva and salivary gland extracts were studied. The kallikrein content of the saliva of man and several lower animals, as affected by different stimulation methods, is analyzed and tabulated.

Wertheimer, E. and G. Battez, 1909. ACTION DE L'ATROPINE SUR LES FILETS EXCITO-SALIVAIRES DU SYMPATHIQUE CHEZ LE LAPIN [Action of atropine on the salivary efferent sympathetic fibers of the rabbit]. *Compt. rend. de la Soc. de Biol. (Paris)*, 66 (22): 1018-1020.

A cannula was introduced in Stensen's duct to measure saliva flow from the parotid glands of curarized rabbits. Intravenous injection of atropine sulfate produced a variable response; in rabbits weighing between 2.5 and 3 kg. a dose of 50 mg. generally suppressed saliva flow.

Wertheimer, E., and L. Boulet, 1911. ACTION DU CHLORURE DE BARYUM SUR LES SÉCRÉTIONS PANCRÉATIQUE ET SALIVAIRE [The effect of barium chloride on pancreatic and salivary secretion]. *Compt. rend. de la Soc. de Biol. (Paris)*, 71 (25): 60-62.

Injection of barium chloride (5 to 10 mg. per kg.) into a vein of a dog stimulated the submaxillary gland in the same manner as pilocarpine. Barium chloride appears to act on the terminals of the secretory nerves as salivation occurs after sectioning of the cerebral and sympathetic secretory fibers but is usually abolished by injection of strong doses of atropine.

Wertheimer, E., and G. Battez, 1913. SALIVATION PROVOQUÉE PAR AUGMENTATION DE LA PRESSION ARTÉRIELLE [Salivation induced by increase of arterial pressure]. *Compt. rend. de la Soc. de Biol. (Paris)*, 75 (25): 16-17.

Experiments were carried out on a curarized dog after sectioning the spinal cord at the level of the third vertebra and the pneumogastric nerve of the neck.

In order to compare the effects on salivation of excitation of nerves independent of increased arterial pressure, the splanchnic nerve and the brachial plexus were stimulated. Stimulation of the splanchnic caused salivation and a rise in arterial pressure, while brachial plexus stimulation caused only salivation. Excitation of the nerve was considered to have two effects, reflex and direct, which could be separated. Bulbar excitation was transmitted exclusively by the chorda tympani since the sympathetic nerve fibers were cut with the pneumogastric. When the chorda was cut, the corresponding gland did not react to increased arterial pressure.

Wessinger, George D., 1940. COMPARATIVE MEASUREMENTS OF SALIVARY pH BY THE QUINHYDRONE AND GLASS ELECTRODES. *Jour. dental Res.*, 19 (3): 297-298.

"Previous investigations by the author have demonstrated that there are compounds in saliva which can serve as hydrogen donors for the reduction of pyruvic to lactic acid. Since the measurement of salivary pH by the quinhydrone method is an oxidation-reduction reaction it seemed desirable to investigate the results obtained by this method as compared to the glass electrode. The differences obtained by the 2 methods varied somewhat but the average difference for 50 measurements was 0.08 pH units. The quinhydrone method usually gives a lower value. Attempts were made to measure the oxidation-reduction potential of saliva to determine if a correlation existed between this and the deviation in pH by the 2 methods. Redox potentials of saliva have

not as yet been successfully measured because of polarization effects. Further work is in progress." (Complete paper.)

Wessinger, George D., 1941. COMPARATIVE MEASUREMENTS OF SALIVARY pH. Jour. dental Res., 20 (2): 123-127.

The unstimulated salivas of 50 dental patients were pooled and divided into two portions. The pH of one portion was determined by the quinhydrone method; of the other, with a glass electrode. The values obtained by the former ranged from 6.15 to 7.27; those obtained with the latter, from 6.16 to 7.25. A comparison of the two measurements indicated that differences ranged from 0.01 to 0.13 pH units (aver. 0.08), the values obtained by the quinhydrone method being consistently slightly lower than those obtained by the glass electrode.

Because of the difficulty in measuring the oxidation-reduction potential of saliva, attempts to correlate the differences in pH of the two methods with oxidation-reduction potentials were unsuccessful. The author indicates that theoretically the deviation in pH by the quinhydrone method will probably be the greater the farther removed the oxidation-reduction potential is from zero.

Weyrauch, F., and J. Rzymkowski, 1938. PHOTOGRAPHIEN ZUR TRÖPFCHENINFEKTION [Photographs concerning droplet infection]. Zeitschr. f. Hyg. u. Infektionskrankh., 120 (5): 444-449.

Photographic procedures for the study of droplet expulsion and transmission in speaking and sneezing are described.

Wheatcroft, M. G., and J. L. Nemes, 1951. EFFECT OF X-RADIATION ON LYSOZYME ACTIVITY OF SALIVA. Jour. dental Res., 30 (4): 494.

"A series of saliva samples (pilocarpine stimulated) were collected from 4 male dogs of approximately 25 pound weight, before and after exposure to x-radiation dosages of 200, 400 and 600 r (total body). The lysozyme activity of the samples remained constant over a period of 3 months, pre- and postradiation, and was unchanged when the total blood and salivary white cell counts decreased to zero. The lysozyme activity was not affected by the varying amounts of saliva produced. Dogs receiving 400 r and 600 r developed hemorrhagic gingivae and large necrotic mouth lesions of tongue and cheek with associated increase of bacterial organisms. Since the lytic property remained high, even with dogs in moribund state, and in the presence of gross mouth infections, the question of the actual purpose and importance of this defense mechanism is further complicated." (Complete paper.)

Wheatcroft, M. G., and J. L. Nemes, 1952. DEMONSTRATION OF HYALURONIDASE IN SALIVA BY THE STREPTOCOCCAL DECAPSULATION. Jour. dent. Res., 31 (4): 468.

"Salivas of 50 individuals have been tested for the presence of hyaluronidase. A test has been devised employing encapsulated Group C mucoid beta hemolytic streptococci as the substrate (Murray and Pearce, Canad. J. Res. 37: 254. 1949.) One of the components of the capsular material is hyaluronic acid. The enzyme hyaluronidase causes a depolymerization and hydrolysis of the capsular material resulting in the gradual disappearance

of the capsular zone. This test is reported to be more sensitive than other tests employed in the test. Turbidity or viscosity of the saliva do not interfere with the results. Of the 50 individuals tested by this method all but one showed the presence of hyaluronidase in the saliva." (Complete paper.)

Wheatcroft, M. G., 1957. A COMPARATIVE STUDY OF HUMAN SERUM AND SALIVARY ANTIBODY TITERS IN CASES OF BRUCELLA MELITENSIS INFECTIONS. Jour. dent. Res., 36 (1): 112-117.

Two hundred and nineteen saliva and sera samples, collected from 73 patients with Brucella melitensis infections, were examined by the complement-fixation and tube agglutination technique to form a comparative study of antibody titers. Eighty per cent of the salivas were positive for brucella antibody when the sera contained a titer of 1:80 or over. Salivas from control individuals were consistently negative. Concentration of the negative salivas from clinical patients with a serum titer of 1:80 or over showed the antibody to be consistently present, when tested by the tube agglutination method. Concentration of the saliva of control individuals gave negative results. It was not possible to use the complement-fixation test on concentrated salivas because of the concentration of anti-complementary factors in the saliva. A statistical association in the amount of antibody in the sera and saliva from each patient was shown by correlation analyses. In the complement-fixation tests the correlation coefficient obtained was .674 and in the agglutination tests the correlation coefficient was .524. Tables are presented showing the distribution of the comparative titers by the complement-fixation and agglutination tests. (Author's summary.)

Whelan, W. J., and P. J. P. Roberts, 1952. ACTION OF SALIVARY α -AMYLASE ON AMYLOPECTIN AND GLYCOGEN. Nature, 170 (4331): 748-749.

A preliminary report is made of the action of salivary α -amylase on rabbit liver glycogen. Fractionation on charcoal as well as paper chromatographic tests of the products, formed by exhaustively treating the glycogen with purified enzyme, showed the presence of maltose, maltotriose, and dextrans having α -1:6-branch linkages; a tetrasaccharide fraction was absent. The branched dextrin of lowest molecular weight was a pentasaccharide. After treatment of the branched dextrin with R-enzyme and fractionating on charcoal the following substances were identified: maltose maltotriose, maltotetraose, maltopentaose, and dextrans of higher molecular weight. The results are consistent with the hypothesis that salivary α -amylase can hydrolyze all linkages except α -1:4 links adjacent to the branch link of a polysaccharide.

White, Abraham G., H. Gordon, and L. Leiter, 1950. STUDIES IN EDEMA. II. THE EFFECT OF CONGESTIVE HEART FAILURE ON SALIVA ELECTROLYTE CONCENTRATIONS. Jour. clin. Invest., 29 (11): 1445-1447.

A study was made of the concentration of electrolytes in the paraffin-stimulated saliva of patients with congestive heart failure, 27 of whom were on a low salt regimen and 11 of whom were on a regular salt intake; 10 non-cardiac subjects on a low salt diet and 16 non-cardiac subjects on a regular salt diet were studied as

controls. Results indicated that congestive heart failure is associated with lowered sodium, lowered chloride, and higher potassium concentrations in the saliva. The saliva of cardiac and non-cardiac patients on a low salt diet showed no significant difference in electrolyte concentrations; subjects on regular salt diets showed significantly lower salivary sodium and chloride concentrations in the heart failure patients as compared with the non-cardiac subjects.

White, Julius, and Russell W. Bunting, 1935. AN INVESTIGATION INTO THE POSSIBLE RELATIONSHIP OF AMMONIA IN THE SALIVA TO DENTAL CARIES. *Jour. Amer. dent. Assoc.*, 22 (3): 468-473.

Paraffin-stimulated saliva samples (25 cc. each) of 37 persons, 9-40 years of age, were examined for pH and for ammonia content by a modification of the aeration method of Folin (*Zeitschr. f. physiol. Chem.* 37 (2): 161. 1902), in an effort to establish a possible relationship between salivary ammonia content and caries incidence. Marked variations were observed (cf. Tables 1 and 2, p. 469-470); no significant difference, however, occurred between the salivary ammonia contents of carious and caries-free individuals.

White, Julius, and R. W. Bunting, 1935a. AMMONIA CONTENT OF SALIVA IN RELATION TO DENTAL CARIES. *Jour. dent. Res.*, 15 (3-4): 175-176.

An abstract of White, J., 1935.

White, Julius, and R. W. Bunting, 1936. CHEMICAL COMPOSITION OF STIMULATED AND NON-STIMULATED SALIVAS IN RELATION TO DENTAL CARIES. *Jour. dent. Res.*, 15 (5): 336-337.

Comparative study of Ca, P, pH, CO₂-capacity, ash, and total solids, of resting and stimulated salivas (paraffin chewing) of 12 caries-free and 13 caries-susceptible children -- 9 to 16 years. Outgrowth of criticism by Becks and Wainwright of work of Hubbell and Bunting on ground nonstimulated salivas were used. Data for stimulated salivas confirmed work of Hubbell and Bunting. Although there were greater amounts of Ca and P, and much lower CO₂-capacity, in resting salivas, values obtained for caries-free individuals were in same range as those for caries-susceptible. In both stimulated and non-stimulated saliva, therefore, Ca and P contents bear no relationship to caries. (Author's abstract)

White, Julius, and Russell W. Bunting, 1936a. A COMPARISON OF THE CHEMICAL COMPOSITION OF STIMULATED AND RESTING SALIVA OF CARIES-FREE AND CARIES-SUSCEPTIBLE CHILDREN. *Amer. Jour. Physiol.*, 117 (3): 529-532.

The chemical composition of resting and paraffin-activated saliva of 25 public school children, ranging in age from 9 to 16 years, were made. The subjects arrived at 6:30 in the morning and were allowed to relax for 15 min. Resting saliva was collected by having the child tip his head forward with mouth open, allowing the saliva to flow from his mouth without the movement of the tongue or jaws. After 15 to 18 cc. were collected, the subject was allowed to rest 15 min.; then a second sample was collected following paraffin stimulation. No significant difference was found regarding the order in which the resting or stimulated salivas were collected.

Immediately after collection, the pH (colorimetric) and the carbon dioxide capacity were determined. The remainder of the saliva was centrifuged at a high speed for 30 min. A portion of the saliva was placed in a platinum dish and dried at 110° overnight in an electric furnace to determine the total solids. The dried material was ashed in an electric muffle. The ash was then dissolved in HCl and aliquots of the solution were used for phosphorus determinations. Other samples of the centrifuged saliva were treated with 20% trichloroacetic acid, shaken and allowed to stand 10 min. The precipitate was removed by filtration and the filtrate analyzed for calcium. Analyses of 4 different samples of saliva of each subject were made.

The following average values were obtained for resting and activated salivas of 12 caries-free children (average age of 12.4 years): Rate of secretion of resting saliva, 0.46 cc./min., of stimulated saliva, 1.52 cc./min. pH of resting saliva, 6.6, of stimulated, 7.17. Constituents per 100 cc. of saliva: total solids of resting saliva, 407 mg., of stimulated, 472 mg.; ash of resting saliva, 108 mg., of stimulated, 113 mg.; calcium of resting saliva, 5.79 mg., of stimulated, 4.99 mg.; phosphorus of resting saliva, 16.0 mg., of stimulated, 13.3 mg.; carbon dioxide capacity of resting saliva, 10.3 cc., of stimulated, 40.6 cc.

White, Julius, Russell W. Bunting, Kenneth Thomson, and Philip Jay, 1937. RELATION BETWEEN DENTAL CARIES AND POTASSIUM AND SODIUM CONTENTS OF SALIVA. *Jour. dent. Res.*, 16 (4): 315.

Spectrographic and chemical analyses were made of eighty saliva samples from caries-susceptible and caries-free individuals. A correlation was seen between the occurrence of caries and a high K content (above 50 mg./100 cc. saliva), while a low K content (below 35 mg./100 cc.) was associated with the absence of caries. No relationship was noted between Na content and caries. (Author's abstract)

Wiener, Alexander S., and Isidore Kosofsky, 1941. QUANTITATIVE STUDIES ON THE GROUP-SPECIFIC SUBSTANCES IN HUMAN BLOOD AND SALIVA. I. GROUP-SPECIFIC SUBSTANCE B. *Jour. Immunol.*, 41 (4): 413-428.

"A method is presented for standardizing isoagglutinating sera to be used for estimating the concentration of group-substances in blood and secretions. It is shown that when the maximal dilution of blood or saliva that neutralizes the isoagglutinating serum or serum-dilution is plotted against serum-dilution, the curves for saliva and blood are quite different. This makes it difficult to determine the relative amounts of group-substances in blood and saliva. The cause for the difference in the curves is presumably related to the intrinsic difference in the test-methods for blood and secretions, namely, the absorptive and inhibitive techniques, respectively. The experiments described for the standardization of sera were performed with the blood and saliva of a single group-B individual. Anti-B sera from various sources gave quite different findings, so that it was not possible to predict the results merely from the concentration of agglutinins in the serum or serum-dilution. In the absorptive tests the blood of different group-B individuals

were found to give equivalent results whether they were secretors or non-secretors. Moreover, the saliva of different group-B secretors, or of the same group-B individual at different times, was found to be relatively constant in its content of group-specific substance. Saliva, accordingly, is a particularly favorable material for use as a basis for standardization or quantitative studies on group-specific substances." (Authors' summary.)

Wiener, Alexander S., and Isidore Kosofsky, 1941. QUANTITATIVE STUDIES ON THE GROUP-SPECIFIC SUBSTANCES IN HUMAN BLOOD AND SALIVA. II. GROUP-SPECIFIC SUBSTANCE A, WITH SPECIAL REFERENCE TO THE SUBGROUPS. *Jour. Immunol.*, 42 (4): 381-393.

"With the quantitative technic described in a previous paper comparative studies were carried out on the group-specific substance A in human blood and saliva using human Group-B serum and anti-A immune-rabbit serum. From the reactions of the blood of A₁ and A₂ individuals, the presence in the human serum of two isoagglutinins, α and α_1 , was readily confirmed; on the other hand, the behavior of the anti-A immune serum indicates that it contains but one sort of alpha antibody, which reacts more intensely with A₁ than with A₂ blood. In contrast to the reactions of the blood, only slight differences were detected between the group substances in the salivas of individuals of the two sub-groups, A₁ and A₂. In fact, in one test it was not even possible to distinguish the saliva of an A₃ individual, by its reactions, from A₁ and A₂ salivas. While definite differences were found in the reactivities of salivas from two A₂B individuals as compared with salivas of Group A, these were much smaller than the differences between the corresponding bloods. These observations indicated that the A substances in saliva and blood are different. Further evidence of the difference between the group-substance A in saliva and blood was furnished by comparing the reactions with human-B serum and anti-A immune-rabbit serum, the former giving higher titers with saliva than with blood, the latter acting more intensely with blood than with saliva, at least in the case of subgroup A₁. As had been previously found for the saliva of Group-B individuals, so also for Group-A individuals there was not much variation in the concentration of the group-substance in saliva not only in the same individual at different times, but also among different individuals.

"Some practical applications in forensic medicine of the examination of secretions for their content of group-specific substances are briefly discussed." (Authors' summary.)

Wiener, Alexander S., and Ruth B. Belkin, 1943. GROUP-SPECIFIC SUBSTANCES IN THE SALIVA OF THE NEW-BORN. *Jour. Immunol.*, 47 (6): 467-470.

In contrast to the results obtained by Hartman [cf. Hartmann, 1941], the authors found that in a series of 30 pairs of saliva samples from mothers and their new-born infants, the distinction between secretors and non-secretors of group-specific substances in saliva was as definite in the infants as in the mothers. Method is fully described.

Willetts, N. P., S. Rosen, H. J. Stafseth, H. R. Hunt, and C. A. Hoppert, 1957. A COMPARISON

OF SALIVARY PROTEASE ACTIVITY IN THE HUNT-HOPPERT CRIES-RESISTANT AND CRIES-SUSCEPTIBLE RATS. *Jour. dent. Res.*, 36 (2): 223-229.

A study was made to compare the protease activities of the saliva of the Hunt-Hoppert caries-resistant and caries-susceptible rats. In mature animals, the saliva of susceptible males displayed from 2.6 to 3.2 times as much protease activity as that of resistant males. Mature susceptible females showed 2.1 to 2.6 times the activity of resistant females. Susceptible males exhibited slightly greater activity than susceptible females in rats 88 to 125 days old. However, these differences were not observed in rats prior to puberty or in rats older than 125 days. Activity increased sharply with age in the case of susceptible animals, whereas much smaller changes were found in resistants of comparable ages. The possible relationship of protease activity to caries was discussed. (Author's summary)

Williams, Ned B., 1944. IMMUNIZATION OF HUMAN BEINGS WITH ORAL LACTOBACILLI. *Jour. dental Res.*, 23 (6): 403-411.

The author studied whether any increase in lactobacillus-specific blood agglutinin titers could be associated with a decrease in the salivary counts for lactobacilli. Paraffin-stimulated saliva was collected upon arising in the morning. Dilution and plating were begun within 2 or 3 hours after collection. Persons with counts exceeding 40,000 lactobacilli per cc. of saliva were selected for the experimental group. Salivary counts were made 16 to 32 times in the subjects of the experimental group (20) and the control group (13) over a period of 4 months, and again 6 to 10 times over a period of 5 weeks about 2 months later.

Strains were chosen from the results of cross agglutination tests between 40 stock lactobacillus antigens and their immune rabbit sera. The course of injections consisted of 4 subcutaneous inoculations at weekly intervals, living and heat-killed vaccines being given simultaneously. Each person received 7 cc. of vaccine, totaling about 7,400 million lactobacilli.

"Vaccination increased the blood agglutinin titers for the strains used in the vaccines, the maximum being attained around 2 weeks after vaccination. The titers decreased after this period and were near the unvaccinated levels 5 months after the last injections. Controls showed no appreciable change in titer.

"Salivary counts for lactobacilli over a period of 4 months demonstrated that 15 out of 20 persons (75%) in the immunized group had apparent reductions in average salivary counts. Statistical analysis indicated that only 5 out of the 20 (25%) could be regarded as having reductions greater than could be accounted for by chance. The average counts for lactobacilli in the controls showed changes which were within the limits of chance variation.

"The average agglutinin titer levels were about the same for both sections of the immunized group, one with reductions in average counts within the limits of chance variation. No relationship could be established between the blood agglutinins and the changes in average counts.

"The results seem to indicate that the immunization, as performed in this study, had no

consistent effect on the numbers of lactobacilli cultivable from the oral cavity." (From the author's summary.)

Williams, Ned B., 1944a. SALIVARY COUNTS IN HUMANS FOLLOWING VACCINATION WITH ORAL LACTOBACILLI. Jour. dental Res., 23 (3): 196-197.

"An equal mixture of 2 widely cross agglutination organisms, among stock strains of oral lactobacilli, was used for subcutaneous inoculation of 23 human volunteers, once weekly for a period of 4 weeks. Heat-killed as well as living types of vaccine were injected simultaneously in opposite arms. Responses to living vaccine were more intense than to heat-killed, but both were characterized by soft pink areas which disappeared in 4 to 5 days without abscess formation or any induration. Agglutination tests between sera and vaccine strains demonstrated that increases in titers were maximal from 2 weeks to 1 month after vaccination. Later there was a gradual decrease until at 5 months only a few showed titers above their previous "normal" levels. Tests, under similar conditions, of 13 unvaccinated controls demonstrated no changes in their titers. Salivary counts for oral lactobacilli were averaged before and after for persons in the vaccinated as well as in the unvaccinated groups. Statistical analysis of the averages in the former group revealed that 6 of the 23 had reductions in count greater than could be accounted for in the basis of chance. Among the remaining 17 in this group, 7 showed an increase in count and the others had reductions which were within the limits of chance variation. No significant differences were observed in the control group. . . . it is concluded that the salivary counts for lactobacilli are not appreciably affected by the increased blood agglutinin titers following subcutaneous injection of oral lactobacillus vaccines." (Complete paper.)

Williams, Ned B., 1948. FACTORS IN IMMUNITY AND SUSCEPTIBILITY TO DENTAL CARIES. Jour. dent. Res., 27 (1): 101-108; discussion, 109-110.

A review is presented of immunologic studies on the relationship between dental caries, salivary lactobacillus counts, and serum agglutination titers. Caries immunity was found associated with presence of antibodies in sera and absence of lactobacilli in saliva. Use of salivary lactobacillus vaccines produce no significant reduction in salivary counts, a temporary increase in agglutination titer of sera was found.

Williams, Ned B., Mary Alice Judson, and Charles F. Eickenberg, 1949. A STUDY OF THE OCCURRENCE OF ENTEROCOCCI, LACTOBACILLI AND YEASTS IN SALIVA FROM MAN. Jour. dental Res., 28 (6): 639.

"Interest in the frequency of occurrence of enterococci in the salivas of persons of all ages was stimulated by the isolation and identification of a strain of *Streptococcus faecalis* from a culture obtained from an infected root canal. The salivas were collected in the morning just after arising. The presence of enterococci was indicated by growth and acid production after inoculation and incubation (45°C.) of a broth containing sodium azide, glucose, and bromthymol blue. All positive tubes were studied further for isolation and identification of the microorganisms. Quantitative determinations of

lactobacilli and yeasts were made by inoculating tomato juice agar (pH 5.0) with dilutions of the same salivary samples. *Str. faecalis*, *Str. liquefaciens* or *Str. zymogenes* were identified from 45 of 206 children and adults varying in age from 4 through 40 years. Enterococci were isolated each time from 5 of 10 persons who contributed saliva on from 2 through 7 different occasions. *Str. faecalis* was found sporadically or every time in all salivas while *Str. liquefaciens* was found twice and *Str. zymogenes* once in 3 separate samples from one person. Lactobacilli were found on almost every occasion, but yeasts did not appear with as great regularity. A comparison of the numbers of lactobacilli in the salivas positive for enterococci with those in negative salivas showed that the mean number of lactobacilli in positive salivas showed was greater than the mean number in negative salivas. A statistical analysis of these data indicated that the difference between these means was significant." (Complete paper.)

Williams, N. B., M. A. Forbes, E. Blau, and C. F. Eickenberg, 1950. A STUDY OF THE SIMULTANEOUS OCCURRENCE OF ENTEROCOCCI, LACTOBACILLI, AND YEASTS IN SALIVA FROM HUMAN BEINGS. Jour. dental Res., 29 (5): 563-570.

Four hundred and thirty-three saliva samples were collected from 206 persons over a three-month period and were examined for the presence of yeasts, lactobacilli, and enterococci. A total of 45 persons (66 samples) were positive for one or more of these organisms: 21 of 98 persons (21.4%) between the ages of 4-13 years; 13 of 58 persons (22.4%) between 14-20 years; and 11 (22.2%) of 50 persons 21 years or over. The order of frequency of occurrence of the organisms was: *Streptococcus faecalis* (82.2%) of the positive, *S. liquefaciens* (11.1%), and *S. zymogens* (6.6%).

An inverse relationship between lactobacilli and yeast counts appears to exist when enterococci are present.

Williams, Ned B., and C. F. Eickenberg, 1952. EFFECTS OF SONIC VIBRATION ON THE NUMBERS OF MICROORGANISMS CULTIVABLE FROM HUMAN SALIVA. Jour. dental Res., 31 (4): 470-471.

"A series of studies were carried out to compare the effects of mechanical shaking and sonic vibration on the numbers of cultivable microorganisms in saliva. Saliva was collected from 4 human beings, pooled and divided, one portion was treated on a shaker delivering about 85 cycles/second and the second portion was exposed to sonic vibration at a frequency of 9,000 cycles per second, power output of 50 watts. Standard 1.0 ml. aliquots were removed at varying time intervals diluted and inoculated on blood agar in Petri plates. The plates were incubated aerobically at 37°C. for 48 hours, then all colonies appearing on the plates were counted. It was found that the counts from the 2, 6, 15 and 30 minute aliquots from the sample treated by sonic vibration were 5 times higher, and the count from the 10 minute aliquot was 10 times higher than the counts from similar aliquots of the sample treated by mechanical shaking. The counts from all aliquots of the sample treated by mechanical shaking were not markedly increased even after 30 minutes. Different lots of pooled saliva gave similar results after sonic vibration over similar time periods, but counts were reduced

if exposure was continued for 45 minutes and a marked reduction was noted after 60 minutes. A few runs to determine the effect of sonic vibration on lactobacillus counts indicated that the counts could be doubled, the optimum exposure time seemed to be between 6 and 15 minutes." (Complete paper.)

Williams, N. B., and C. F. Eickenberg, 1952. EFFECTS OF SONIC VIBRATION ON THE NUMBERS OF MICROORGANISMS CULTIVABLE FROM HUMAN SALIVA. Jour. dental Res., 31 (3): 428-439.

"1. A comparison of the numbers of colonies appearing on a blood agar medium after exposing separate aliquots of pooled saliva to sonic vibration (9,000 cycles per second, power output 50 watts) and to a mechanical shaking method, indicates that significantly higher counts were consistently obtained after sonic vibration. It is likely that these differences are due to a more homogeneous dispersion of bacteria after sonic vibration.

"2. The effects of sonic vibration on the counts may be noted as early as after 2 minutes of exposure, but the highest counts seem to be obtained after about 10 minutes. After reaching a maximum the counts become lower as the time of exposure is increased.

"3. Similar effects may be noted on the numbers of colonies of streptococci and lactobacilli when aliquots from the sample are inoculated on separate media.

"4. The possible use of sonic vibration, or some similar method for studying quantitative relationships between bacteria cultivable from saliva is suggested.

"5. Various phases in the future study of the effects of sonic vibration on samples of saliva are discussed." (Authors' summary.)

Williams, Ned B., C. F. Eickenberg, and B. M. Florey, 1953. A PRELIMINARY REPORT ON THE QUANTITATIVE INTERRELATIONSHIPS OF MICROORGANISMS CULTIVABLE FROM HUMAN SALIVA. Jour. dent. Res., 32 (5): 691-692.

A study was made of the microbial flora of paraffin-stimulated saliva. Samples were serially diluted and 9 different media, mostly selective, were inoculated to obtain colony counts of *Streptococcus salivarius*, lactobacilli, fusiforms, staphylococci, yeasts, an unidentified gram-negative diplococcus, various kinds of streptococci, and various kinds of gram-negative bacteria. Total colony counts of oral bacteria were made using a non-selective media. Preliminary results indicated that the relative number of colonies of various organisms differed in children and adults, between samples from different persons and from the same person on different days. Quantitative interrelationships of the various microorganisms, however, appeared to be characteristic for each person.

Williams, Ned B., C. F. Eickenberg, and O. Oshtry, 1954. CHANGES IN THE RELATIVE PROPORTIONS OF ORAL BACTERIA DURING TOPICAL APPLICATION OF PENICILLIN. Jour. Dental Res., 33 (5): 689.

A study was made of the relative proportions of oral organisms in the salivas of 2 male subjects before, during, and after a 2-week period of use of 25000-unit potassium penicillin troches. The test subjects, aged 23 and 25, had identical

DMF scores of 18 and were on essentially identical diets. Salivary samples were collected on arising 4 times during the week prior to use of the troches, 6 times a week during the 2-week period of use, (3/day), and 5 times a week during the 2 weeks after their use.

Results of the duplicate counts show that no changes occurred in the relative numbers of yeast or staphylococci during the 5-week period. The relative numbers of total bacteria, total streptococci, *Streptococcus salivarius*, fusobacteria, and *Neisseria* were reduced during use of the troches, with a gradual return to pre-penicillin levels. Lactobacilli levels dropped during the first week of penicillin use, then returned to pre-penicillin levels during the 2nd week of use. The relative numbers of total gram-negative bacteria and of gram-negative bacilli increased steadily during the period of use. The gram-negative bacilli reached their maximum counts during the 2nd week then decreased; the total gram-negative bacteria reached a maximum, after use of the troches was stopped, where the level remained constant during the rest of the study period.

Topical application of penicillin under the test conditions was found to change the relative proportions of a majority of the organisms studied in the saliva. (From the author's abstract.)

Williams, Stanley, Beryl Splatt, and Rachel Jakobowicz, 1940. THE CONCENTRATION OF SULPHANILAMIDE IN THE SALIVA FOLLOWING ORAL ADMINISTRATION. Med. Jour. Australia, 1 (4): 120-124.

"Seven patients were given sulphanilamide by the Rehfuss tube in doses ranging from 40 to 104 milligrammes per kilogram of body weight. The figures obtained for the blood sulphanilamide level were remarkably constant for the same dose (Figure I); but no such correlation could be observed in respect of salivary excretion of the drug. ...At the time the drug reached its maximum concentration in the blood, the concentration in the saliva varied from 6% to 86% of that in the blood in the case of free sulphanilamide, and from 5% to 93% in the case of total sulphanilamide. Conversely..., when the concentration in the saliva was maximal, the free sulphanilamide in the saliva was from 7% to 119% of that in the blood at the corresponding time. If these results are considered from the point of view of a possible threshold in the blood for excretion of sulphanilamide in saliva, the 'total' threshold values indicated in the seven patients were greater than 5.9, between 3.1 and 4.6, less than 2.3, between 2 and 5 milligrammes per centum. In four cases...all the samples of saliva contained the drug, and the results might be interpreted as indicating that in these subjects it tended to be uniformly distributed and that there was no real threshold above which the drug was excreted; or alternatively, that if a lower threshold existed, this was lower than the lowest concentration of sulphanilamide observed in the blood.

"The number of patients examined is too small to be adequate as a basis for general discussion of the mechanism of excretion of sulphanilamide in the saliva. The series is, however, sufficiently large to settle one of the points at issue in this investigation---namely, the apparent failure to provide prophylaxis against scarlet fever with this drug. Thus though a dose of six grammes (70 or more milligrammes per kilogram of body weight)

appears to ensure excretion of a reasonable amount of sulphanilamide into the saliva, a dose of four grammes (50 milligrammes per kilogram of body weight) was not adequate to cause such a secretion. It is unlikely, therefore that the saliva of the adults in the scarlet fever ward who were taking 3.0 grammes of 'Proseptosine' daily, or that of the children receiving a dose of 1.5 grammes, contained sulphanilamide in concentrations sufficient to be effective." (Authors' discussion.)

Wills, J. H., and J. C. Forbes, 1936. FACTORS INFLUENCING ACID-NEUTRALIZING POWER OF SALIVA. *Jour. dent. Res.*, 15 (5): 337.

Effects of several common factors upon acid-neutralizing power of saliva investigated. High protein-low carbohydrate diet increased, high carbohydrate-low protein diet decreased, it. Thorough cleansing of teeth after each meal, to remove food particles: no influence. Addition of spinach to diet raised acid-neutralizing power to value above level of diet alone. In general, single carbohydrate meal produced marked fall in acid-neutralizing power, with gradual return to general level of diet. Single protein meal produced first rise and then return to dietary level. Usually maximum effect obtained about 1 hour after meal; at end of 2.5 hours, acid-neutralizing power approximated original level. Neutralizing power, after chewing sponge rubber, chewing gum, or paraffin, for five minutes, generally increased, but elevation not constant; in two cases, decrease followed gum chewing. Smoking, and cleaning teeth, produced very transient elevations of acid-neutralizing power. (Author's abstract.)

Wills, J. H., and W. O. Fern, 1938. POTASSIUM CHANGES IN SUBMAXILLARY GLANDS DURING STIMULATION. *Amer. Jour. Physiol.*, 124 (1): 72-76.

The potassium (K) content of the submaxillary gland and its secretion was measured in cats following electrical and pilocarpine stimulation. Cats were anesthetized with Dial; 24 experiments were conducted with electrical stimulation of the lingual nerve and 15 with pilocarpine. The right and left submaxillary glands were stimulated alternately in successive experiments. During the stimulation, the saliva was collected and measured. After a certain period, the stimulated and the control glands were removed and weighed; then dried and weighed.

There was no significant difference between the amount of K secreted by the gland in the saliva and the amount taken in by the gland during secretion. The control glands contained 35.4 millimols of K per 100 g. dry weight and the stimulated glands, 36.0 mM. There was a greater variation in water content on the stimulated side than on the control side.

In experiments with pilocarpine there was no significant change in the water content of the gland during secretion; but the K content of the stimulated gland decreased from 33.4 to 35.4 mM per 100 g. dry weight; however, there was no greater production of saliva than before and this saliva contained a normal amount of K. It was suggested that pilocarpine has some specific effect on the intake of K by the gland.

Wills, J. H., and J. C. Forbes, 1939. DIETARY EFFECTS UPON THE ACID NEUTRALIZING POWER OF THE SALIVA. *Jour. dental Res.*, 18 (5): 409-415.

The effects of dietary factors upon the ability of saliva to neutralize acid were studied.

A comparison was made of the acid-neutralizing power of resting and stimulated (chewing gum, paraffin, sponge rubber) salivas. Saliva samples (about 4 cc.) were collected from each of 6 male subjects. Two drops of a 0.4% solution of methyl red in 95% ethyl alcohol were added to 3 cc. of each sample and the mixture was titrated (0.01 N HCl) to the appearance of a distinct red color; the number of cc. of HCl used in this titration was taken as an index of the acid-neutralizing power. In general, the effect of chewing (increase of acid-neutralizing power) was roughly proportional to the resistance offered the jaws by the material in the mouth; the increases were, however, not constant.

The same individuals were then placed on each of 3 diets for successive periods of 3 to 4 weeks each. The average composition of diet P (protein) was 40% protein, 35% fat, and 25% carbohydrate; of diet N (normal), 25%, 20%, and 55%, respectively; and of diet C (carbohydrate), 18%, 15%, and 67%. A significant difference in salivary acid-neutralizing power occurred between the subjects on diet C and those on diet P. A probable factor contributing to this difference is that the consumption of vegetables on diet P (5%) was higher than on diet C; it had previously been shown that the addition of spinach to diets free of leafy vegetables increased the average salivary acid-neutralizing power by 0.5 cc.

It is questioned whether or not the dietary effects upon the acid-neutralizing power were strictly systemic or whether the acid-neutralizing power was affected directly by food particles impacted in the mouth. A modified Lashley cannula [cf. Lashley, 1916] was attached to the mouth of one subject (region of the right parotid duct) for a period of about 2 months, during which time the subject was placed on the different diets. Samples of both parotid and mixed salivas were collected and compared; results were calculated from 14 consecutive tests. On the normal diet, the average acid-neutralizing power of mixed saliva was 1.5; of parotid saliva, 1.3. On the protein diet, the average values were 2.3 and 2.1, respectively. Results indicated that different diets affect the acid-neutralizing power of saliva through some systemic means.

Diurnal variations (caused by various types of lunches while the subjects were on the various diets) were recorded. A lunch corresponding in composition to the diet effected a change in the same general tendency of the diet; a lunch of opposite composition caused a change in the reverse direction to that of the diet, with a return towards the general dietary level.

Wills, J. H., 1940. THE SECRETION OF INTRA-VENOUSLY INJECTED FLUORINE IN THE SUBMAXILLARY SALIVA OF CATS. *Jour. dent. Res.*, 19 (6): 585-590.

"When radioactive fluorine was injected intravenously into cats during secretion by the submaxillary gland, the injected material appeared in the saliva in significant amount within 1 minute after its administration. Under such conditions an average of 0.082 per cent of the fluorine entered the saliva during the 21 minutes following the injection. In similar experiments with radioactive chlorine 0.365 per cent of the injected material was excreted in the saliva within 23 minutes.

"When fluorine was injected into resting cats, the submaxillary gland not being stimulated until 50 minutes later, an average of 0.020 per cent of the fluorine was excreted in the saliva during the 21 minutes following the commencement of stimulation.

"The ratio of saliva fluorine to plasma fluorine had an average value of 0.098; the similar ratio for chlorine was 0.389." (Author's summary.)

Wills, J. H., 1941. SOME FACTORS IN SECRETION BY SUBMAXILLARY GLANDS OF CATS. *Amer. Jour. Physiol.*, 134 (3): 441-449.

The effects of various frequencies of electrical stimulation of the chorda tympani upon the secretory response of the submaxillary gland were studied in cats anesthetized with Dial. The submaxillary duct was cannulated and the secretory flow was registered by a drop counter. The venous blood of the gland was also collected.

The optimal rate of electrical stimulation appeared to be about 9 shocks per second. At this frequency the initial high secretory output was best maintained.

In experiments on the simultaneous variations in the blood flow of the submaxillary gland and the salivary flow with both chorda and pilocarpine stimulation, the author compares his findings on the cat with those in the literature on the dog. It is concluded that the amount of saliva produced in both the cat and dog at a given blood flow is greater with pilocarpine stimulation than with chorda excitation.

Wills, J. H., 1941. ELECTROLYTE CHANGES IN SUBMAXILLARY GLANDS DURING STIMULATION. *Amer. Jour. Physiol.*, 135 (1): 164-174.

In the continuation of earlier investigations (cf. Wills et al., 1938), the effect of electrical and pilocarpine stimulation on the electrolyte contents of the submaxillary gland its secretion were studied in cats and dogs anesthetized with Dial. The duct of one submaxillary gland was cannulated. In the electrical stimulation experiments, the chorda-lingual trunk of the chorda tympani was cut close to the bulla and the peripheral section was stimulated. Salivation lasted 35 min. Pilocarpine was injected intravenously (femoral) or intra-arterially (superior laryngeal artery). Blood samples were also obtained; venous blood was taken from a vein of the gland; arterial from the femoral artery.

In cats, the potassium, calcium, and phosphorus contents of the saliva produced during pilocarpine stimulation were not significantly different from those of the saliva secreted during chorda excitation. However, the pilocarpine saliva contained greater concentrations of sodium and chloride. The average flow rate of pilocarpine saliva was slightly below that of chorda saliva.

In dogs, the calcium and phosphorus contents were higher, and the potassium lower, in pilocarpine saliva than in that produced during chorda stimulation. The average rate of secretion after pilocarpine injection was slightly greater than one-half that after chorda stimulation. It is stated that at similar rates of flow pilocarpine and chorda salivas of dogs would probably show the same chief differences in composition as do those of the cat.

Arterial, venous, and salivary samples were collected under oil for pH determinations. The

samples were equilibrated at room temperature with a mixture of 5% CO₂ and 95% O₂ and the pH redetermined. The alkali reserve changes were measured by this latter method. The saliva was found to be always more basic than the blood. Pilocarpine saliva became more basic after equilibration with the CO₂-O₂ mixture, while chorda saliva became more acid.

Blood lactic acid concentration definitely increased after both electrical or pilocarpine stimulation. There was more than three times as much lactic acid in pilocarpine saliva as in chorda saliva, although there was no marked difference in rates of secretion with the two types of stimulation.

Wills, J. H., 1942. SECRETION OF INTRAVENOUSLY INJECTED ELECTROLYTES IN SUBMAXILLARY SALIVA OF CATS. *Jour. dent. Res.*, 21 (3): 324-325.

Radioactive sodium, potassium, chlorine, fluorine, and phosphorus appeared in submaxillary saliva within one minute after injection via the femoral vein during salivary secretion, produced by either chorda stimulation or pilocarpine injection. Pilocarpine administration again, after injection of radioactive material, usually augmented secretion of electrolyte. The average rates of secretion (ppm. injected per min.) were: for chorda saliva, Na, 9; K, 135; Cl, 214; F 40; and P, 18; for pilocarpine saliva these values were Na, 15; K, 106; Cl, 90; and P, 27. (Author's abstract)

Wills, J. H., 1943. SECRETION OF INTRAVENOUSLY INJECTED ELECTROLYTES IN THE SUBMAXILLARY SALIVA OF CATS. *Jour. dental Res.*, 22 (1): 27-31.

Radioactive compounds (containing isotopes of sodium, potassium, chlorine, fluorine, or phosphorus) were injected into the femoral veins of cats and salivary flow was stimulated by either chorda excitation or pilocarpine injection. All the materials appeared in the submaxillary saliva within one minute after injection. A second injection of pilocarpine was administered and a sample collected; thereafter, samples were collected regularly at ten-minute intervals. The rate of secretion of chlorine and sodium was enhanced "by increases in both rate of salivary secretion and concentration of the saliva"; that of phosphorus and potassium, solely by an increase in the rate of saliva production. Potassium was engulfed from the blood by the submaxillary gland (at a time when the specific activity of the blood was high) and appeared in the saliva after a time lag (probably at a time when the specific activity of the gland had become greater than that of the blood plasma).

Willstätter, Richard, Eugen Bamann, and Margarete Rohdewald, 1930. ÜBER DIE ENZYME DER SPEICHELDRÜSE. DRITTE ABHANDLUNG ÜBER ENZYME DER LEUKOCYTEN [On the enzymes of the salivary gland. Third paper on the enzymes of leucocytes]. *Hoppe-Seyler's Zeitschr. f. physiol. Chem.*, 186: 85-96.

The enzyme contents of saliva and of the salivary glands were studied in man, dog, horse, and pig. The salivary glands exhibited marked proteolytic action, comparable to that determined for leucocytes, trypsin, and cathepsin; no pepsin was observed. Both fresh saliva and centrifuged saliva showed proteolytic activity which, even in the centrifuged saliva, was attributed to

leucocytes, sloughed-off lymphocytes, and micro-organisms. The protease resembled trypsin in activity. A peptidase was also found. The amylase content of saliva was twice that found in the salivary glands.

Winslow, C. E. A., 1909. AN INVESTIGATION OF THE EXTENT OF THE BACTERIAL POLLUTION OF THE ATMOSPHERE BY MOUTH SPRAY. *Jour. Amer. med. Assoc.*, 53 (22): 1845.

Although tuberculosis is transmissible by the mouth spray of a coughing consumptive patient, danger of air-borne infections in general is slight since most droplets are coarse and settle rapidly.

Winslow, C. E. A., and Dorothea H. Sanjiyan, 1924. ACID-FORMING STREPTOCOCCI AS INDICES OF FOMITES POLLUTION. *Jour. Bacteriol.*, 9 (6): 513-525.

A series of over 1000 different tests was conducted to determine the abundance of acid-forming streptococci upon objects of various sorts and to determine any relationship between their presence and the degree of pollution to which such objects were exposed. The tongue and objects exposed to mouth contamination were among the areas tested.

Winslow, C. E. A., L. P. Herrington, and Jean Hume Nelbach, 1942. THE INFLUENCE OF ATMOSPHERIC TEMPERATURE AND HUMIDITY UPON THE DRYNESS OF THE ORAL MUCOSA. *Amer. Jour. Hyg.*, 35 (1): 27-39.

A review is presented of the work on the actual drying effect of expired and inspired air upon the oral mucosa. The data indicate that the drying effect of the respired air seems to be a function of the vapor pressure.

Experimental work, most of which was done on two subjects, showed that with vapor pressures of .40 inch Hg or over, the oral mucosa is relatively moist; a marked drying occurs at vapor pressures below .40 inch, to the extent that the surface moisture is approximately one-half of that obtaining at higher vapor pressures. Drying of the oral mucosa therefore occurs under the following conditions: at air temperatures below 55°C. regardless of moisture content; at 60°C. with less than 77% relative humidity; at 70°C. with less than 54% relative humidity; and at 80°C. with less than 39% relative humidity.

Winsor, A. L., 1928. CONDITIONS AFFECTING HUMAN PAROTID SECRETION. *Jour. exper. Psychol.*, 11 (5): 355-363.

A preliminary study was made of the effect of muscular activity in processes as yawning and sneezing, of stimulation from muscles involved in vocalization, of chewing on one side of the mouth, of the condition of the stomach, of strained muscular activity, and of sleep on the human parotid secretion.

Winsor, A. L., and T. L. Bayne, 1929. UNCONDITIONED SALIVARY RESPONSES IN MAN. *Amer. Jour. Psychol.*, 41 (2): 271-276.

Studies indicate that a series of actions (contractions and relaxations) of the masseter, temporal, and pterygoid muscles is accompanied by an increased salivation rate. Data suggests that the secretory rate of the parotid gland is constantly being affected by stimulatory impulses originating from these muscles of mastication, and

it is noted that upon an increase in muscular tension there is a concurrent increase in the rate of salivation.

Recent research is mentioned concerning the existence of a neural connection along which afferent impulses may be conveyed from the three masticatory muscles to the salivary centers.

Winsor, A. L., 1930. FACTORS WHICH INDIRECTLY AFFECT PAROTID SECRETION. *Jour. exper. Psychol.* 13 (5): 423-437.

A literature review is given on the subject of conditioned salivary reflexes, and makes an attempt to explain previous findings in light of new data based on comprehensive studies of the effects of various factors on parotid salivation rate under experimental conditions. Winsor concludes, on the basis of comparative studies, that parotid secretion is affected by several environmental, emotional, and reflex factors, and demonstrates that conditions of lessened efficiency, lessened attentiveness, uninterest, and fatigue tend to accompany reduced salivary rates. Using himself and a 12 year old boy as subjects, the author found that reduced salivary rates are related to disturbing or emotional situations which are followed by an approach of the parotid secretion rate to its former level when the disruption has subsided.

Winsor, A. L., 1930a. THE EFFECT OF DEHYDRATION ON PAROTID SECRETION. *Amer. Jour. Psychol.*, 42 (4): 602-607.

The salivary flow from Stenson's duct was collected under three sets of circumstances (normal, chewing, and mouth breathing) to determine the condition in which a state of dehydration can be best evaluated. The estimation of the state of dehydration by measuring the amount of salivation resulting from chewing appeared to be the most satisfactory technique. Test procedures encompassed a period of several days, but dehydration effects similar to those resulting from 24-70 hours of water starvation are produced in one hour by immersing the subject's body in a bath of 100°F.

Thirst is found to be experienced after the second day although the mucous membranes of the mouth are kept moist by chewing motions.

Winsor, A. L., 1931. THE EFFECT OF MENTAL EFFORT ON PAROTID SECRETION. *Amer. Jour. Psychol.*, 43 (3): 434-446.

The salivary secretion rate of the parotid gland was diminished directly with the intensity of the mental effort of the individual. This is attributed to a probable restraining influence of the cerebral cortex; the "voluntary activity of salivary flow" is superimposed upon and inhibits postural tonicity.

Winsor, A. L., 1932. THE EFFECT OF CIGARETTE SMOKING ON SECRETION. *Jour. gen. Psychol.*, 6 (1): 190-195.

An investigation was made of salivary secretory changes in the parotid gland during and following cigarette smoking in five regular smokers and five non-smokers. A suction disc was secured to the parotid duct and connected to a measuring device, and the patient instructed to avoid oral activity. A control period lasted for 20 minutes at the end of which all subjects were instructed to smoke (with inhalation of the tobacco smoke) for

five minutes; the succeeding secretions were noted for a period of 30-40 minutes.

It was noted in the regular smokers that under favorable conditions they showed an initial conditioned salivary reflex to the sight of a cigarette. In general, smoking was followed by a salivary inhibition in the non-smokers, but with prolonged excitation of salivation in the group of smokers; the durations of the inhibition or excitation were about the same. It was suggested that the novice's early experience with tobacco smoking is characterized by inhibition of salivation or of sympathetic functioning.

Winsor, A. L., and B. Korchin, 1938. THE EFFECT OF DIFFERENT TYPES OF STIMULATION UPON THE pH OF HUMAN PAROTID SECRETION. *Jour. exper. Psychol.*, 23 (1): 62-79.

A study was made of the pH and rate of flow of the parotid saliva of male and female subjects, aged 13 to 23 years, under varying conditions and using various secretogogic agents. Results showed a definite relationship between the rate of flow and the pH; the more rapidly flowing secretions were more alkaline in reaction, while slower rates of flow were paralleled with a more acidic reaction. This relationship was found to exist regardless of the nature of the secretogogic agent. Greater stimulation of 1 gland was accompanied by a higher salivary pH than was found in the less active gland. Diurnal variations in pH were found to be related to the previous activity of the gland; a more acid secretion was found to accumulate in the alveoli of the glands after excessive activation than during periods of rest or inhibition.

The pH of normal, inactivated parotid saliva varied from 5.52 to 6.13 with an average of 5.83; activated secretions of a pH as high as 8.18 were obtained.

Winsor, A. L., and B. Korchin, 1939. TECHNIC FOR THE STUDY OF SECRETIONS FROM THE ORAL MUCOSA IN HUMANS. *Proc. Soc. exper. Biol. Med.* 40 (1): 116-117.

The following technique was developed to facilitate the collection and measurement of activated (stimulated) and inactivated (not stimulated) secretions from the oral mucosa of human subjects: small, disc-shaped metal cups are fastened by suction onto the oral mucosa. The disc consists of two concentric chambers, each supplied with a rubber tube passing out through the mouth. The secretion flows through the inner chamber, pushing a bead of water through a capillary tube attached to the rubber tubing leading out from the inner chamber. The pressure of both activated and inactivated secretions is sufficient to move the bead of water through the capillary tubing.

An hour is sometimes necessary before a 0.05 cc. inactivated saliva sample can be collected, while activated secretions (obtained by chewing dry bread, for example) may be procured much more readily.

Winsor, A. L., and B. Korchin, 1940. SOME OBSERVATIONS ON THE EFFECT OF MENTAL ACTIVITY UPON PAROTID SECRETION. *Jour. Gen. Psychol.*, 22: 25-32.

It is demonstrated in this study that mental activities effect the rate of secretion of both

parotid salivary glands. Sensory efforts of various kinds may cause a decrease or an increase in parotid secretion as exemplified by salivation reactions to eye strain and radio listening. Determinations of pH reveal that slow flowing or inhibited secretions are more acid than those of fast flowing or "relaxed" secretions. In general, those subjects with ordinarily low secretion rates display an increase in salivation during mental tension, while the secretion rates of those persons with normally high rates decrease.

Different personality types show differences in salivary secretion rate, and it is therefore suggested that these parotid secretion rate tests could possibly be used as personality studying devices.

Witebsky, Ernst, and Werner Henle, 1933. DIE SEROLOGISCHE SONDERSTELLUNG DES SPEICHEL [The serological specificity of saliva]. *Zeitschr. f. Immunitätsforsch.*, 80 (1-2): 108-120.

Rabbits treated with centrifuged, inactivated human saliva, produced antisera which reacted with their specific salivary antigens. Antisera produced by injection of human sera, failed to react similarly with saliva. The saliva-specific substance was relatively thermostable. The so-called "group enzyme" is capable of destroying the group-specific substance as well as, under certain circumstances, the saliva-specific substances.

Witebsky, E., and T. Satoh, 1933. ZUR FRAGE DES BLUTGRUPPENFERMENTS UND DER AUSSCHIEDUNG VON BLUTGRUPPENSUBSTANZ [On the blood-group (specific substance) enzyme and the secretion of blood group specific substance]. *Klin. Wochenschr.*, 12 (24): 948-949.

A study is reported concerning an enzyme in body secretions and excretions of the newborn which deactivates blood group specific substance in salivary samples collected from group A subjects.

Witebsky, Ernest, Niels C. Klendshoj, and Stuart L. Vaughan, 1942. OCCURRENCE OF BLOOD GROUP SPECIFIC SUBSTANCES IN GASTRIC JUICE OF PATIENTS WITH PERNICIOUS ANEMIA. *Proc. Soc. exper. Biol. Med.*, 49 (4): 633-636.

Incidental to a series of examinations of the gastric juice of 12 persons with pernicious anemia for blood-group specific substances, the salivas of 2 persons of blood group A, and 2 of group O were examined. Both group-A persons contained A substance in the salivas; while one group-O subject had O substance, the other was found to be a non-secretor. The so-called inhibition of agglutination test was used.

Witebsky, Ernest, 1946. ISOLATION AND PURIFICATION OF BLOOD GROUP A AND B SUBSTANCES; THEIR USE IN CONDITIONING UNIVERSAL DONOR BLOOD, IN NEUTRALIZING ANTI-Rh SERA, AND IN THE PRODUCTION OF POTENT GROUPING SERA. *Ann. N.Y. Acad. Sci.*, 46 (9): 887-898

Horse saliva was used as an early source of blood group specific substance B; it has since been determined that the gastric mucosa of that animal is a more reliable source.

Wisotzky, Joel, 1954. POLAROGRAPHIC ANALYSIS OF PARAFFIN-STIMULATED EARLY MORNING SALIVARY SAMPLES. *Jour. Dental Res.*, 33 (5): 689-690.

The polarographic blood serum cancer test was applied to saliva by denaturation of salivary samples with KOH, precipitation with sulfosalicylic acid, the filtrates then being polarographed in $\text{CoCl}_2\text{-NH}_4\text{Cl-NH}_3$ buffer in the voltage range of -1.4 to -2.0 v. Results showed the presence of a mucopolysaccharide-like substance in saliva similar to that revealed in blood serum during various disease states. Data were also obtained from the salivary donors on calculus, hyperemia and edema of gingival tissue, P.M.A., caries score, as well as salivary streptococcus and lactobacillus counts. Paper-weight analysis of polarographic curve areas showed large differences between individuals in the -1.7 to 1.9 voltage range. A tendency to a low streptococcal count disappeared when area values were large; no such relationship between area values and the lactobacillus count existed. (From author's abstract)

Wisotzky, Joel, 1958. ELECTROCHEMISTRY OF SALIVA. Jour. dent. Res., 37 (1): 27.

These studies cover the following electrochemical approaches applied to saliva and saliva-sugar systems in order to gain insight about the potential energy existing in sugared salivary systems which might be available as energy for initiating caries. The polarographic technique was utilized in an attempt to ascertain semiquantitatively the oxygen tension fall and simultaneous build up of reducing particles in a small area of the settling fraction in standing saliva. The results tend to indicate that there is a build up of negative particles oxidizable at a platinum electrode as the oxygen tension falls. Oxidation-reduction studies of saliva-sugar systems indicate that a large potential energy may exist, which if properly coupled, could provide energy for the initiation of caries. Also indicated in this series, is the electrical nonhomogeneity of saliva and the sensitivity of the electrode potential to agitation. Potentiometric titration of heavy metallic ions such as Au^{+++} , Pt^{++++} , Pd^{++} , and Cu^{++} by saliva indicates a rapid reduction of the metals by saliva. Such reductions show some evidence of proceeding in stepwise fashion. (Author's abstract)

Wittkower, E., and W. Pilz, 1932. ÜBER AFFEKTIVE-SOMATISCHE VERÄNDERUNGEN. VI. ZUR AFFEKTIVEN BEEINFLUSSBARKEIT DER SPEICHELSEKRETION On emotional-somatic changes. VI. On the effect of emotion on salivary secretion. Klin. Wochenschr., 11 (17): 718-719.

The effect of emotions (i.e., joy, sorrow, fear, disgust, and anger) on salivary secretion was studied in 27 persons---11 hypnotized and 16 non-hypnotized.

Quantitative experiments indicated that emotions consistently increase salivary flow in some individuals, and consistently decrease it in others. The test persons were separated accordingly: those belonging to the former group were called "plus" types; those in the latter, "minus" types.

Qualitatively noticeable changes in thiocyanogen and nitrogen contents were observed after emotional experience. In one "plus type" person, the amount of salivary secretion increased from 7.5 to 21 cc.; the N amount decreased from 72.8 to 40.32 mg./100 cc., and returned to 70.2 mg./100 cc. after the emotional stimulation had subsided;

and the thiocyanogen content decreased from 0.21 to 0.11 mg./100 cc. In one "minus type" person, the salivary secretion decreased from 4.1 to 0.85 cc.; the N content increased from 5.6 to 44.8 mg./100 cc., returning to 4.48 mg./100 cc. afterwards; and the thiocyanogen content rose from 0.8 mg./100 cc. to 0.95 mg./100 cc., returning to 0.8 mg./100 cc.

Wohlgemuth, J., 1908. ÜBER EINE NEUE METHODE ZUR QUANTITATIVEN BESTIMMUNG DES DIASTATISCHEN FERMENTS [On a new method of quantitative determination of diastatic enzymes]. Biochem. Zeitschr., 9: 1-9.

Reviews previous methods and describes the author's own method of diastatic enzyme determination of saliva and other fluids.

Wohlgemuth, J., 1908. UNTERSUCHUNGEN ÜBER DIE DIASTASEN. I. DIE TIERISCHEN DIASTASEN Examination of diastase. I. Animal diastase. Biochem. Zeitschr., 9: 10-43.

The effects of various chemicals on human and animal diastase production are discussed. The quantity of diastase in human saliva fluctuated; it was usually greater following absorption of food. No diastase occurs in pure gastric juice of the dog, nor in saliva-free human gastric juice. Neutralized gastric juice enhanced salivary content; NaCl however, increased the enzyme production ten-fold in 24 hours. Alkali inhibited the effect of diastase. Neutral salts behaved differently. While sodium-phosphate, sodium oxalate, had an inhibitory effect, sodium nitrate, sodium nitrite, and sodium chlorate had a promoting effect; sodium sulphate had no effect on diastase production.

Woldring, M. G., 1955. FREE AMINO ACIDS OF HUMAN SALIVA; A CHROMATOGRAPHIC INVESTIGATION. Jour. dent. Res., 34 (2): 248-256.

Chromatographic analysis was made of the ultrafiltrate from the paraffin-stimulated salivas of 5 persons by means of fractionation columns of Dowex-50, a sulfonated polystyrene resin. Quantitative determinations were made photometrically. Separation of the ninhydrin-positive components of the salivas showed the presence of 18 amino acids. In addition to the majority of the known amino acids thus demonstrated to occur in saliva, taurine, urea, creatinine, ammonia, and a number of unknown substances are also considered present. Tabulated results show that values for salivary amino acids, determined by this method, are in most cases lower than those obtained by microbiologic methods. (Kirch et al, 1947)

Wolf, Charles G. L., and Joseph Barcroft, 1914. THE METABOLISM OF THE SALIVARY GLAND. I. THE NITROGEN METABOLISM OF THE RESTING GLAND. Jour. Physiol., 49 (1-2): 95-112.

The non-protein-nitrogen exchange of the submaxillary glands of dogs was quantitatively measured. It was determined that during various periods the glands take in more NPN from arterial blood than is released to venous blood, that an equilibrium may exist between the glandular NPN uptake and output, and that on occasions more NPN is released to the venous blood than is picked up from the arterial blood. Generally, urea exchange was small compared to that of the total NPN. It was indicated that a change in the rate of submaxillary blood flow does not alter the metabolic exchange of non-protein-nitrogen.

Wolf, E. Alfred, and J. D. O'Neal, 1942. AMYLASE ACTIVITY OF HUMAN PAROTID AND SUBMAXILLARY-SUBLINGUAL SALIVA. *Anat. Rec.*, 84 (4): 460.

The amylase activity of parotid and submaxillary-sublingual (s-s) saliva was determined in 8 individuals. Parotid saliva showed a higher amylase activity in all cases tested; s-s amylase ranged from 3 to 37 percent of the parotid with one case having a value of 88 percent. Low values of parotid amylase corresponded with high values of s-s amylase and conversely.

Wolf, E. Alfred, 1952. QUANTITATIVE TESTS FOR SALIVARY AMYLASE BY A NEW METHOD. *Federation Proc.*, 11 (1): 174.

A new method of testing for salivary amylase is described. The mean values obtained in 9 adults were as follows: parotid saliva, 32.5 units [unit = the reciprocal of the time required for completion of the digestion of a starch solution (achromatic iodine point), times 100], sublingual-submaxillary secretions, 5.9; in 16 adolescents, values obtained were 39.4 and 7.9 units, respectively in females, 30.6 and 4.8 in males 39.3 and 8.6 in Negroes, and 34.2 and 5.3 in Whites. A linear correlation was observed between the sublingual-submaxillary activity and the rate of metabolism/kilogram body weight. The author concludes that the strength of the salivary amylase activity is a constitutional characteristic of the individual.

Wolfe, A. D., and N. C. Turner, 1957. STUDIES ON SALIVARY PEROXIDATIC ACTIVITY. *Jour. dent. Res.*, 36 (6): 843-851.

A test for peroxidase activity toward guaiacol has been adapted for use with saliva. The pH relationship of the salivary peroxidase activity toward guaiacol has been determined and other biochemical aspects investigated. Salivary "tryptophane" levels are markedly decreased upon hydrogen peroxide introduction into the supernatant of centrifuged saliva. The effective salivary peroxidase activity toward guaiacol of two series of children has been investigated by this test: Series A No.=290 Mean 15.87 sec. Sigma= $\pm$ 7.50 sec. Series B No.=293 Mean 16.25 sec. Sigma= $\pm$ 7.53 sec. Individual children were classified according to their dental caries activity in the past 6 months. The corresponding salivary peroxidase activities were grouped and compared. The group with the least dental decay activity had salivary peroxidase levels significantly different from the group with the most dental decay activity. A relationship between the salivary peroxidase activity and the time of the amyloclastic phase of starch breakdown was observed. With respect to peroxidatic activity, sibling pairs appear to be more closely related to each other than to their group as a whole. Salivary peroxidase has been discussed with respect to some aspects of its possible interrelationship with carbohydrate metabolism and other areas of physiologic significance. (Author's summary)

Wolff, H. G., and W. Horsley Gantt, 1935. CAFFEINE SODIOBENZOATE, SODIUM ISO-AMYLETHYL BARBITURATE, SODIUM BROMIDE AND CHLORAL HYDRATE: EFFECT ON THE HIGHEST INTEGRATIVE FUNCTIONS. *Arch. Neurol. Psychiat.*, 33 (5): 1030-1057.

The effect of certain drugs on the salivary reflex was studied in two dogs.

The method used for studying the conditioned responses was a modification of that developed by Pavlov. A salivary fistula was produced on each dog's left cheek by dissecting the ampulla of Stenson's duct and everting it so that it drained on the outside of the cheek. The parotid saliva was collected by placing a glass cup over the outlet of the duct. The glass cup was connected to a manometer. The animal was placed in a chamber constructed in such a way that the experimenter was able to control the environmental circumstances. This consisted of a sound-proof compartment with an inner chamber, measuring 2x2x2 m., with walls 30 cm. thick. The dog stood on a platform in front of an automatic food box. The animal was secured only by a strap tied to its collar. On the wall of the inner chamber were buzzers, metronomes, lights, etc., controlled from the operator's keyboard. The salivary production was measured directly by the manometer and recorded by an electric drop recorder. Conditioned responses to a number of stimuli were developed: the ringing of a bell, a bubbling sound made by passing a stream of air through a bottle of water near the dog's head, the sound of a metronome with 60 or 140 beats per minute, a light flashing at a frequency of 60 flash per minute. These stimuli were coupled with the presentation of food (biscuits). Experiments were performed at approximately the same hour daily except Sunday.

In the control series, the bell and the bubbling sound elicited a greater salivary response, 222 and 231 cc., respectively, than the other two stimuli; the sound of the metronome at 60 beats per minute, 189 cc., and the flashing light, 151 cc. The sound of a metronome with 140 beats per minute usually elicited little or no salivary response.

Observations on the effect of the drugs on the salivary response were made in a number of experiments. The agent was administered, and the responses to the various standard stimuli were determined and compared with the control series. The experimental data are very detailed and do not permit a reproduction in abstract form. The following drugs were studied:

Caffeine sodiobenzoate was injected intramuscularly in the amount of 0.016 g./kg. (total, 0.4 g.); results are presented in Tables 3 and 4 and Chart 1.

Sodium iso-amylethyl barbiturate was given intraperitoneally in varying doses of a 10% aqueous solution: 30 mg./kg. (total, 725 mg.); 15 mg./kg. (total, 375 mg.); and 7.5 mg./kg. (total, 0.1875 mg.); results are given in Table 5 and 6 and Chart 2.

Sodium bromide was administered in an enema containing amounts of 120 mg./kg. in a 5% aqueous solution (total, 3 g) and 280 mg./kg. (total, 7 g.); results are presented in Table 7.

Chloral hydrate was also administered rectally in the amount of 100 mg./kg. (total, 2.5 g.) in 5% aqueous solution; results are given in Table 8.

The conclusion is reached that caffeine sodiobenzoate lowers and sodium iso-amylethyl barbiturate, sodium bromide, and chloral hydrate raise the threshold of conditioned responses.

Wollstein, Martha, 1918. AN EXPERIMENTAL STUDY OF PAROTITIS. *Jour. Amer. med. Assoc.*, 71 (8): 639-644.

An investigation was made of the effects of sterile salivary-filtrate injections, from human

parotitis cases, on the parotids and testicles of cats. The presence of the mumps virus in the saliva of humans and cats was also studied.

Wolman, Irving J., B. Evans, S. Lasker, and K. Jaegge, 1947. AMYLASE LEVELS DURING MUMPS. *Amer. Jour. med. Sci.*, 213 (4): 477-481.

The amylase level of blood serum and paraffin-stimulated saliva was determined, by starch-iodine tests, in 101 adult males ill with mumps. Both specimens were collected before breakfast; the saliva was immediately diluted 1:100 with a Sorensen buffer pH 6.8 and kept chilled till tested. There was no evident correlation between amylase levels of serum and saliva. The serum amylase was found to be elevated in the majority of cases, while the saliva amylase seemed a little lower in mumps cases than in the controls.

Wright, D. E., and G. N. Jenkins, 1953. THE LEUKOCYTE COUNT OF SALIVA SPECIMENS FROM CARIES-FREE SUBJECTS. *Jour. Dental Res.*, 32 (5): 733.

Samples of saliva were obtained from 11 caries-free and 16 caries-active individuals; samples were unstimulated or wax-stimulated, the latter being collected for single 5-minute periods or for five successive 2-minute periods. These collections were made both with and without preceding 2-minute periods of tooth brushing and mouth rinsing with distilled water. All specimens were examined, after thorough mixing, on a hemocytometer slide under the phase microscope. Two types of leukocytes were differentiated: intact or well-preserved cells, and those in varying stages of disintegration; counts were made of intact and of total (both types) leukocytes. In all cases the numbers of intact cells were greater in the salivas of caries-free subjects than those from caries-active subjects, the ratio varying from 2:1 to 7:1 dependent on the method of collection. The total numbers of leukocytes were similar in the two groups of subjects. As there was no difference in gingival condition, relative differences in inflammatory state of the gums do not explain the higher percentage of intact cells in the caries-free saliva. (From author's abstract)

Wright, Donald E. and G. N. Jenkins, 1953a. AN OBSERVED CORRELATION BETWEEN AMMONIA CONCENTRATION AND ACID PRODUCTION IN SALIVA. *Jour. dent Res.*, 32 (2): 232-238.

A study of the paraffin-stimulated saliva of over 300 subjects indicated a statistically significant positive correlation existed between the ammonia concentrations of both initial and incubated samples of saliva and their ability to produce acid on incubation with glucose. The observed correlation is discussed but is not accounted for.

Wright, Donald E. and G. N. Jenkins, 1953b. LEUKOCYTES IN THE SALIVA OF CARIES-FREE AND CARIES-ACTIVE SUBJECTS. *Jour. dent. Res.*, 32 (4): 511-523.

Leukocyte counts were made of samples of saliva of 11 caries-free individuals, 16 who were caries-active, and 2 who were caries-low, using a hemocytometer slide and observing directly under a phase contrast microscope. The percentage of intact salivary leukocytes was significantly greater in caries-free than in caries-active

saliva, while the total number of leukocytes was similar in both types of saliva. The volume of saliva secreted by caries-free individuals was also significantly greater than that secreted by the caries-active. No consistent correlation was noted between the number of intact leukocytes and the condition of the gingivae of the subjects.

Wright, D. E., 1958. STUDIES ON THE DISINTEGRATION OF LEUKOCYTES IN SALIVA ON INCUBATION. *Jour. dent. Res.*, 37 (4): 756-757.

Previous studies (Wright, D. E., 1953) showed that the count of complete undamaged leukocytes referred to as "intact" cells--in saliva specimens from caries-free subjects was approximately 4 times greater than that observed in caries-active samples. Other experiments (Wright, D. E., 1953) demonstrated the constancy with which this relationship was obtained despite varied methods of collection of samples. One possible explanation of this observation is that there exists a slower rate of disintegration of leukocytes in the mouths of caries-free subjects. Five samples of wax-stimulated saliva, taken at weekly intervals, were obtained from 4 caries-free and 5 caries-active subjects. An aliquot was diluted with an equal volume of 0.5 per cent saline and was incubated at 37 C. with agitation. At zero time, and at 5- or 10-minute intervals, counts were made of the intact leukocytes present and were continued until all intact cells had disintegrated. The results showed that despite a greater total number of intact leukocytes in the caries-free samples, the rate of disintegration was more than twice as great as in the caries-active samples. Thus, differences in the rate of disintegration cannot explain the observation that the count of intact cells is greater in caries-free subjects. (Author's abstract)

Wu, Daisy Yen, and Hsien Wu, 1951. DETERMINATION OF UREA IN SALIVA. *Proc. Soc. exper. Biol. Med.*, 75 (1): 130-132.

"Using Conway's micro-diffusion technic [Conway, E. J., and A. Byrne, *Biochem. Jour.* 27: 419. 1933], urea plus ammonia determinations can be made with 1 ml or less of saliva. Sufficient saliva for duplicate analyses can be collected in a few minutes without artificial stimulation. Saliva collected in this manner gives reproducible values in the same individual." (Authors' summary.)

The salivary urea values of 9 normal persons at various intervals over a 10-hour period are tabulated (Table I, p. 132).

Wwedensky, N., 1927. OBERFLÄCHENERGIE EINIGER PHYSIOLOGISCHER FLÜSSIGKEITEN. Surface energy of certain physiological solution. *Biochem. Zeitschr.*, 188 (4-6): 270-278.

Saliva is cited as a surface-active physiological solution.

Yamakami, K., 1926. THE INDIVIDUALITY OF SALIVA, WITH REFERENCE TO ITS PROPERTY OF INHIBITING SPECIFICALLY ISO-HEMOAGGLUTINATION. *Jour. Immunol.*, 12 (3): 185-189.

Twelve saliva samples from the author, freed from cellular elements and averaging .23 cc. each, manifested a marked inhibiting power upon iso-hemoagglutination, with a degree of specificity. The antiagglutinin is a stable substance, not being destroyed when the saliva was heated to 100°C., it

is extractable with saline solution, remaining unchanged in the dried material for a long time [length of time not specified].

Yardeni, Jacob, 1948. DENTAL CALCULUS. A BACTERIOLOGICAL AND PHYSICAL STUDY. Jour. dent. Res., 27 (4): 532-540.

A study was made of the relation of dental calculus to caries resistance with emphasis on the determination of some protective effect attributable to the calculus itself and not to its mineral content. In a bacteriologic study, direct smears of crushed calculi showed great numbers of gram-positive filaments enmeshed in the calculus, while gram-negative organisms predominated in areas adjacent to the calculi; the internal surface of the calculus was almost sterile. No proteolytic bacteria could be cultivated from the calculus. The salivary flora was predominantly composed of gram-positive bacteria, lactobacilli and streptococci.

The inhibitory influence of calculus on the germination of wheat seed was studied in 5 experiments. Calculus was found to inhibit germination and the degree of inhibition varied from 50 to 8 percent.

No calcium carbonate was found to be present in the calculus section.

Polaroscopic examination of a thin section of calculus indicated that the structural unit of dental calculus is apatite.

Yardeni, Dvora, 1948. HUMAN SALIVA AS A GERMINATION INHIBITOR. Science, 108 (2794): 62-63.

A study was made of the possible germination inhibiting properties of the saliva of normal, healthy persons due to the presence of bacteriostatic elements found to be present in saliva. Immersion of wheat seeds for 48 hours in 7 to 8 ml. of saliva produced definite growth inhibition of the radicles in all cases and a slighter degree of inhibition of the coleoptiles. No correlation was noted between the degree of inhibition produced and the age, sex, or condition of the teeth of the saliva donor. Dilution of the saliva caused the degree of inhibition to decrease.

The inhibiting factor in saliva was found to be heat resistant and nonvolatile; dialysis for 70 to 75 hours almost completely removed it.

Young, D., 1941. PAST AND PRESENT METHODS AND RESULTS OF SUGAR ANALYSIS OF SALIVA. Jour. dental Res., 20 (6): 597-626.

A critical survey of the literature on methods and results of sugar analyses of human and animal salivas is presented; the ultra-micro method (fully described) of Heck, Brown, and Kirk [cf. Mikrochemie, 22: 306, 1937] was found to be the most suitable one in view of the many factors that tend to alter the concentration of glucose in a saliva sample.

Using this method and the deproteinization method of Somogyi, resting and paraffin-activated saliva samples of 16 persons were analyzed. All salivas contained a reducing substance, assumed to be glucose.

In 15 subjects in good health, glucose values for resting saliva ranged from 11.28 to 28.08 mg./100 cc. saliva, and glucose secretion from 0.60 to 10.36 mg./hr.; for activated saliva (10 persons), from 14.04 to 30.00 mg./100 cc. and from 4.54 to 27.82 mg./hr. The remaining individual, suffering

from peptic ulcers, received injections twice daily of 1000 cc. of 10% glucose and atropine administrations. In his resting saliva, the glucose value obtained immediately was 46.08 mg./100 cc. saliva and the secretion, 2.21 mg./hr.; after 30 minutes, 31.80 and 1.91, respectively; and after one hour, 22.92 mg./100 cc., and 5.91 mg./hr. No activated saliva studies were made. 106 refs.

Young, G., H. G. Resca, and M. T. Sullivan, 1951. THE YEASTS OF THE NORMAL MOUTH AND THEIR RELATION TO SALIVARY ACIDITY. Jour. dent. Res., 30 (3): 426-430.

Paraffin-stimulated salivas of 584 healthy college students were examined for the presence of yeasts and their relation to salivary acidity was studied. Yeast cells were cultivated from 284 persons (48.6%), the incidence in men (52% of the male group) being slightly higher than that in women (46% of the female group). High counts ranged from 1,000 to 10,000 per ml., the majority of counts being below 1,000 per ml.

Three hundred yeast-positive subjects were re-tested at the end of one month, and again at the end of 2 months, to determine whether these organisms were normal inhabitants of the oral cavity. At the end of one month, 85% of the group were positive; at the end of two months, 79%. The total percentages of yeast-positive subjects remained fairly constant.

Of 285 yeasts isolated in pure culture, 267 (93.0%) were *Candida albicans*; 6 (21%), *C. tropicalis*; 4 (1.4%), *C. stellatoidea*; 1 (0.3%), *C. pseudotropicalis*; 1 (0.3%), *Candida* sp.; 1 (0.3%), *Candida* sp.; 3 (1.1%), *Cryptococcus* sp.; and 2 (0.7%), *Cryptococcus* sp.

Salivary pH for the 584 individuals ranged from 5.0 to 7.5, the distribution being 6, at 5.0; 44, at 5.5; 134, at 6.0; 190, at 6.5; 168, at 7.0; and 42, at 7.5. The author calls attention to the fact that pH 7.5 is the upper limit of nitrazine sensitivity.

In general, a correlation was seen between the pH and the percentage of yeast positive cultures: the more acid salivas manifested the higher percentages of yeast organisms. All cultures of salivas with pH 5.0 were yeast-positive. The values for other acidities were: 5.3, 83%; 6.0, 67%; 6.5, 52%; 7.0, 29%; and 7.5, 14%.

Youngburg, Guy E., 1932. PHOSPHORUS METABOLISM. IV. THE PHOSPHORUS OF SALIVA, WITH SPECIAL REFERENCE TO DENTAL CARIES. Jour. dent. Res., 12 (2): 267-275. Abstract: Jour. dent. Res., 12 (3): 454.

The mouths of 203 individuals (including 25 nephritics) were rinsed, their salivas collected, and phosphorus determinations made. Results show that 96 percent of salivary P is present as inorganic orthophosphate, the remainder being in protein combination. The inorganic P content of saliva increases slightly with age. The inorganic phosphorus value for 92 normal persons averaged 17.50 mg./100 cc. saliva, that for 86 persons with dental caries, 18.13 mg./100 cc., and that for the 25 nephritics, 17.54 mg./100 cc. saliva. Of the entire group, only 6 persons had phosphorus values above 20 mg., and only 1 above 22.12 mg.; all 6 had dental caries.

Appreciable variation occurred in phosphorus values for the same individual on three days; on April 10, the average value was 16.1 mg. per

100 cc.; on May 18, 14.5 mg./100 cc.; and on October 2, 15.8 mg./100 cc. saliva.

The author concludes that there is no reason to assume that salivary phosphorus plays any role in dental caries.

Youngburg, Guy E., 1936. SALIVARY AMMONIA AND ITS RELATION TO DENTAL CARIES. *Jour. dental Res.*, 15 (5): 247-264.

The relation of the ammonia content of saliva to the presence or absence of dental caries was studied.

The ammonia N content of 4 normal non-carious salivas ranged from 1.28 to 13.66 mg./100 cc. saliva (1 individual gave a value of 16.35 mg./100 cc. immediately after smoking); that of salivas of 45 subjects with active dental caries, from 3.57 to 16.95 mg./100 cc. saliva. The author concludes that there is no characteristic difference in ammonia content between carious and normal salivas, and no indication that ammonia, *per se*, is a determining factor in susceptibility to dental caries.

Zamyckina, K. S., 1933. K VOPROSU O ROLI NERVNOI SISTEMY V OBRAZOVANII FERMENTOV SLIUNNYKH ZHELEZ V ZAVISIMOSTI OT KACHESTVENNO RAZLICHNOGO PITANIYA [On the role of the nervous system in the formation of the salivary enzyme under the influence of qualitatively different diets. Communication 2]. *Ark. Biol. Nauk*, (Leningrad) 34 (1-3): 105-111.

The role of nervous function in the formation of enzymes with regard to qualitatively different diets was studied in the parotid glands in 5 dogs. The diastase content of saliva was determined by the method described earlier (Zamyckina, n.d.), the amylase of the blood determined by Engelgard and Gerchuk's method, and the dry residue measured. Salivary secretion was elicited by 0.25% hydrochloric acid. After experiments in normal parotid glands, the auriculotemporal nerve and its branches, or one branch of the nerve only, were resected in 3 animals, 2 other animals serving as controls.

Tabulated results invariably show absence of diastase in the saliva during the mixed and the meat diet, and the presence of diastase (about 50 mg./100 glucose in the present experiments) during a certain period of the carbohydrate diet (stated in one case as 14 days, not stated in the others). The amount of diastase is noticeably greater in the saliva of the denervated gland than in the normal (about 70 mg./100 glucose in the present experiments).

Both, the saliva of the denervated and of the normal parotid gland contain reducing substances during the meat diet (40 to 177 mg./100 glucose in these experiments) which disappear after the first days of the carbohydrate diet.

There is no difference in the amount of dry residue of normal parotid salivas during the different diets. In the saliva of the denervated gland this amount varied greatly from one animal to the other in the present experiments.

After nerve resection, the parotid gland stops secretion for several weeks, then resumes a secretion which was reduced 2 to 2.5 times in two of the present cases, equal to normal in the other.

The amylase of the blood fluctuated before and after the operation from 150 to 300 mg./100 glucose.

Zamyckina, K. S., 1938. GLYCOLYSIS IN THE ALIMENTARY TRACT. *Bull. Biol. Méd. expér. URSS*, 6 (5): 565-568.

The concentration of lactic acid in the saliva of experimental animals has been found to exceed such concentrations in the blood. In a study of the glycolytic properties of various digestive juices, parotid saliva from fistulated dogs was diluted 50% with water, and 1 cc. of the emulsion distributed to each of four test tubes. Two cc. of a 0.25% solution of glycogen was added to each of two tubes, 2 cc. of water being added to the two controls, and the tubes buffered with 1 cc. of phosphate at pK 7.4. The proteins were precipitated after 3 to 3.5 hours incubation at 39°C. and tests made for the presence of lactic acid. The results showed saliva to display no glycolytic activity.

Zamyckina, K. S., 1940. ROL' SLIUNNYKH, PAN-KREATICHESKOI I KISHECHNYKH ZHELEZ V PROTSESSE EKSKRETSII. SOOBSCHENIE III. [The role of the salivary, pancreatic and intestinal glands in the excretory process. Communication III.] *Biull. eksper. Biol. Med.*, Moskva, 10 (5): 352-355.

Determinations were made of the lactic acid and urate contents of salivary, pancreatic, and intestinal secretions as well as in the blood in two dogs, each having a parotid fistula. Results of 42 experiments show the salivary lactic acid content to vary from 12.4 to 36.3 mg.% in tests conducted at normal room temperature and humidity. The variation in the salivary lactic acid had no direct relationship to salivary dry residue. Tests at an ambient room temperature of 47° to 50°C. and a humidity of 30° to 35° showed the lactic acid level to be unchanged in the saliva but increased 2 to 3 times in the blood.

Zander, H. A., and B. G. Bibby, 1947. LABORATORY AND ANIMAL STUDIES ON THE EFFECT OF PENICILLIN ON CARIES ACTIVITY. *Jour. dent. Res.*, 26 (6): 454.

"In vitro experiments demonstrated that small amounts of penicillin, added to glucose-saliva mixtures, interfered with carbohydrate breakdown. The use of penicillin toothpastes and mouthwashes by student subjects reduced acid production in saliva glucose mixtures even in the absence of marked changes in the oral flora. Neither eating nor smoking reduced the efficacy of penicillin. Hamsters whose teeth were brushed daily with penicillin toothpaste for 34 days showed an average of 1.14 carious teeth per animal; the control brushing group averaged 3.87 carious teeth per animal; the control group (no brushing) averaged 9.25 carious teeth per animal. All animals were on the same caries-producing diet." (Authors' abstract)

Zaus, Earl A., and Leonard S. Fosdick, 1934. EFFECTS OF SALIVA UPON GASTRIC DIGESTION. *Jour. dental Res.*, 14 (1): 3-13.

"(1) Basal flow of saliva averages 0.5 cc. per min., possibly somewhat less. Stimulated saliva flows at the rate of about 2.5 cc. per min.

"(2) Acid neutralizing power of basal saliva showed greater group than individual variations, and compared on the average with 0.017 N NaOH. Stimulated saliva usually ran higher than the basal, and approximated that of 0.025 N NaOH." (From the authors' summary.)

Zaus, E., and G. W. Teuscher, 1940. REPORT ON THREE CASES OF CONGENITAL DYSFUNCTION OF THE MAJOR SALIVARY GLANDS. Jour. dent. Res., 19 (3): 326.

"In 2 of the cases reported there was complete dysfunction, in the other there was slight activity from 1 of the sublingual glands. There was rapid destruction of the enamel with no respect for contact or tooth form. The tips of the cusps are as liable to be affected as any other part of the tooth surface. The cementing substance is destroyed and the enamel rods fall away. Available evidence points to this condition as congenital with failure of the major salivary glands to develop. Other congenital defects may be associated, such as failure of the tear ducts. It is apparent that all treatment to promote the activity of the major salivary glands is doomed to failure. This was illustrated in our cases when they were subjected to diathermy, and injection of the parasympathetic stimulant beta methyl acetylcholine either by subcutaneous administration or by iontophoresis. Explanation of the rampant destruction of the teeth because of the salivary dysfunction involves the following factors: 1. Immunological protection of the saliva; 2. Absence of buffering action of the saliva; and 3. Cleansing action of the saliva." (Authors' abstract)

Zavadovskii, B. M., and A. L. Zack, 1928. K VOPROSU O VLIĖNIĖ SHCHITOVIDNOI ZHELEZY NA VYSSHUIU NERVNUIU DEĖATEL'NOST' U SOBAK. SOOBSHCHENIE I. VLIĖNIE RAZNYKH DOZ SHCHITOVIDNOI ZHELEZY NA USLOVNYE REFLEKSY V PROSTYKH USLOVIĖKH OPYTA [Thyroid gland influence on higher nervous function in dogs. Communication I. The effect of various doses of thyroid gland on the conditioned reflexes under simple conditions of experimentation]. Mediko-biol. Zhur., Moskva, 1928 (1): 15-42.

The effect of induced hyperthyroidism on canine unconditioned and conditioned reflexes was studied in two dogs, each having a fistulated parotid duct, after administration of three massive doses of thyroid. Hyperthyroidism produced an initial general derangement and decrease in conditioned response which lasted one to three days. This was followed by a period of heightened response, lasting up to eight months and characterized by a general increase in nervous excitability, a notable increase in conditioned salivary response, as well as a lesser increase in unconditioned salivation. A detailed discussion and tabular data are given of experimental results.

Zavadovskii, B. M., G. I. Azimov, and V. R. Zakharov, 1929. K VOPROSU O VLIĖNIĖ SHCHITOVIDNOI ZHELEZY NA VYSSHUIU NERVNUIU DEĖATEL'NOST' U SOBAK. SOOBSHCHENIE II. VLIĖNIE RAZOVYKH DOZ SHCHITOVIDNOI ZHELEZY NA USLOVNYE REFLEKSY SOBAK V BOLEE SLOZHNYKH USLOVIĖKH OPYTA [On the influence of the thyroid gland on the higher nervous activity in dogs. Communication II. The influence of single doses of thyroid gland on the conditioned reflexes of dogs under more complicated conditions of experimentation]. Medikobiol. Zhur., Moskva, 1929 (1): 18-31.

Previous findings regarding the effects of thyroid injections on conditioned salivary reflexes in the dog were confirmed in further study using 2 dogs, one an exceptionally stable type and the other a markedly inhibitory type. Induced

hyperthyroidism generally resulted in a period of derangement during the first three to four days and a period of increased excitability 10 to 12 days after injection. Inhibition of reflexes was more pronounced after larger, 50 to 100 gm. doses, while smaller, 10 to 20 gm. doses of thyroid increased excitability. An increase in unconditioned salivary flow was usually found in tests during the first days after inducing hyperthyroidism. The occurrence of abundant spontaneous salivation indicated a thyroid stimulation of cortical salivary centers and, possibly, of salivary gland tissue as well.

Zavadovskii, B. M., V. R. Zakharov, and M. S. Zlotov, 1929. O VLIĖNIĖ SHCHITOVIDNOI ZHELEZY NA VYSSHUIU NERVNUIU DEĖATEL'NOST' U SOBAK. SOOBSHCHENIE III. VLIĖNIE MALYKH, CHRONICHESKIKH DOZ SHCHITOVIDNOI ZHELEZY NA USLOVNYE REFLEKSY SOBAK [On the influence of the thyroid gland on the higher nervous activity in dogs. Communication III. The influence of small, chronic doses of thyroid gland on the conditioned reflexes in dogs]. Mediko-biol. Zhur., Moskva, 1929 (3): 24-35.

Administration of daily 0.5 to 1.0 gm. doses of thyroid, to 2 dogs with well-established conditioned reflexes, has a general neural stimulatory effect without a preceding phase of derangement in reflex activity, such as occurs after administration of larger thyroid doses. The small daily doses shortened latency 23 to 24%, increased the conditioned salivary response 12 to 42% and the unconditioned salivary response 9 to 12%, and decreased the inhibition effect which follows conditioned inhibition or differentiation. The effects of the small daily doses persist for several weeks after administration of the thyroid has been discontinued. These relations are less clear under more complicated experimental conditions or with animals having unstable reflexes.

Zebrowski, Eduard, 1905. ZUR FRAGE DER SEKRETORISCHEN FUNKTION DER PAROTIS BEIM MENSCHEN [On the question of the secretory function of the parotid in man]. Archiv. ges. Physiol., 110 (1-2): 105-173.

Tests were carried out on two hospital patients having parotid fistulas resulting from inflammatory processes occurring in early childhood.

The nature of salivary secretion is conditioned by the combined physical and chemical characteristics prevailing at the time of the stimulation. The quantity of the stimulating substance influences principally the speed of secretion. The concentration of the substances affects the speed of the secretion and to a certain extent the composition of the saliva. A decrease in the concentration of this substance causes a decrease in salivary secretion due to the enrichment of the saliva with organic matters. Mastication exercises a considerable effect on salivary secretion. The alkalinity of the saliva depends directly on its ash content. The digestive ability of newly-collected saliva is higher if it contains more alkali. The effect of the saliva on the digestive process manifests itself in the dilution of gastric juices.

Zeldow, Bernard J., 1955. ANTIBACTERIAL ACTIVITY OF MIXED AND PAROTID HUMAN SALIVA. Jour. dent. Res., 34 (5): 737.

In tests of antibacterial properties of human saliva, mixed or parotid salivas were placed in wells cut in culture medium which was inoculated with *Lactobacillus acidophilus* ATCC #4357; growth was inhibited. Subcultures made from zones of inhibition contained no viable bacteria. The inhibitory component is contained in the supernatant of centrifuged saliva; it is stable when heated at 56°C. for 5 minutes, but inactivated after 5 minutes at 75°C. Concentration by lyophilization resulted in increased zones of inhibition.

The bacterial counts of parotid salivas of 11 subjects were at least 99% lower than those of mixed saliva. A comparison of growth inhibitory activity of the parotid and of mixed saliva of the same subject showed no consistent variation, indicating the inhibitory component to be of non-bacterial origin. Blood serum of 12 subjects, whose saliva showed antibacterial activity, did not inhibit the test organism. These findings suggest that the inhibitory component is a product of the salivary glands. (From author's abstract)

Zeyland, J., and E. Piasecka-Zeyland, 1938. THIOCYANATE ALS DER IM MENSCHENSPEICHEL AUF TUBERKELBACILLEN BACTERICID WIRKENDE FAKTOR [Thiocyanate as the factor in human saliva bactericidal for tubercle bacilli]. Beitr. zur Klinik d. Tuberkulose: 91 (2): 249-251.

Two series of experiments (one on 10, the other on 18 guinea pigs) were conducted to determine the influence of human saliva on tubercle bacilli. The animals were inoculated with tubercle bacilli pretreated with saliva, or in saline solution. All those receiving the saline suspensions of tubercle bacilli developed tuberculous lesions at the point of injection and, with the exception of three animals, tuberculous hematogenous secondary foci; the animals receiving bacteria pretreated with saliva showed no evidence of tuberculosis.

The characteristics of the bactericidal factor in saliva were examined; the factor is thermostable, heating of saliva for 1/2 hour at 56°, 75°, and even 80° has no influence upon the growth inhibitory action.

Since saliva is distinguishable from other body secretions by its thiocyanate content, the influence of potassium thiocyanate alone on tubercle bacilli was studied.

A physiological concentration (0.007-0.01%) was applied to the tubercle bacilli for 24 hours; the solution was clearly bactericidal.

Zherbin, E. A., 1949. K ANALIZU SLIŪNOTDEL'ENIĖ PRI OSTROĖ EKSPERIMENTAL'NOI "ELECTRICHEK-KOĖ" EPILEPSII [On the analysis of salivary secretion during severe experimental "electrical" epilepsy]. In: Mekhanizmy patologicheskikh reaktsii [The Mechanisms of Pathological Reactions], Leningrad, 1949: 11-15, 175-183. Sovet. med. refer. Obozrenie, 1950 (7): 106.

Dogs with parotid fistulas were used to study salivary secretion during short-termed, experimental epilepsy produced by faradic stimulation. It was shown that salivation during experimental epilepsy is the result of direct secretory impulses from the central nervous system to the salivary gland. Injections of atropine block the transmission of these impulses but do not impede

the convulsions. This permits rejection of the theory which attributes the increased salivation to participation of the facial muscles. The chemical composition of the first samples of parotid saliva is typical for secretory response to sympathetic stimulation; the following samples are characteristic of parasympathetic stimulation. This suggests that the epileptic fit represents a stimulation of the sympathetic and parasympathetic branches of the autonomic nervous system.

Ziegler, Mildred R., and L. B. Mendel, 1927. THE TRANSPORTATION AND ELIMINATION OF ORGANIC DYES BY THE ANIMAL ORGANISM. Amer. Jour. Physiol., 82 (2): 299-317.

Thirty-one organic dyes were used in a series of tests on 70 healthy experimental animals, including the rat, rabbit, guinea pig, and dog. All animals except the dog, which received morphine-ether, received urethane-ether anesthesia prior to intravenous injection of the dye. Sodium iodide was then injected similarly to check renal function. No dyes, either unchanged or as a leuko base, were found in any of the salivary samples although iodide was always found present, even when administered in as small a dose as 0.01 mg./kg. in the rabbit. Administration of pilocarpine and of chordal stimulation failed to produce salivary elimination of the dyes. Intravenous administration of 0.06 cc. of a saturated alcoholic solution of phenolphthalein in the rabbit, to check the dye injection technic, was followed by appearance of the dye in the animal's saliva. Passage of the various dyes by other glands and tissues is discussed.

Ziesché, H., 1907. ÜBER DIE QUANTITATIVEN VERHÄLTNISSE DER TRÖPFCHENAUSSTREUUNG DURCH HUSTENDE PHTHISIKER [On the quantitative relationships of droplet-expulsion in coughing phthisics]. Zeitschr. f. Hyg. u. Infektionskrankh., 57 (1): 50-82.

Sixty-two tests, studying the qualitative and quantitative relationships of droplet infection, were made under various conditions using 30 phthisic persons; an almost inclusive tabulation of results is presented (cf. pp. 76-79).

General conclusions are as follows: Only 30-40% of phthisic persons expel tubercle-bearing droplets in coughing. These droplets originate in part from mouth secretions (relatively free of tubercle bacilli) and in part from bronchial secretions (relatively rich in the bacilli). 80% of the agar plates, exposed for 30 minutes at distances of 40-80 cm. from the phthisic, contained less than 400 tubercle bacilli. Since the number of tubercle bacilli believed necessary (by previous investigators) for infection by inhalation ranges between 200 and 400 bacilli, the possibility of infection by infrequent and short-termed contact with phthisics is slight.

An extensive literature review is presented. 44 refs.

Zimmerman, Leo M., 1932. EFFECT OF LIGATION OF THE PAROTID DUCTS ON THE CARBOHYDRATE TOLERANCE OF NORMAL DOGS. Arch. Int. Med., 49 (3): 409-420.

Ligation of the parotid ducts was found to have no effect on the blood sugar level, as has been previously postulated, but may be indirectly responsible for an initial increase in sugar

tolerance which declines progressively. Complete removal or extirpation of the parotids is followed by progressive dilation of the ducts, parenchymal atrophy and fibrosis, and occasionally by a rise in the sugar content of the blood.

Although the findings do not specifically define the parotid gland-blood sugar level relationship, experimental data indicates that the parotid does influence carbohydrate metabolism. It is further suggested that the gland is physiologically related to the pancreas and gonads.

Zimmerman, Leo M., and Samuel Siskin, 1932. EFFECT OF LIGATION OF THE PAROTID DUCT ON THE CARBOHYDRATE METABOLISM OF TOTALLY DEPANCREATIZED DOGS. *Arch. int. Med.*, 49 (4): 663-665.

The effect of ligation of the parotid ducts on carbohydrate metabolism was noted in three depancreatized dogs maintained on a constant diet and receiving insulin in such amounts that varying grades of glycosuria could be produced. Analysis of 24-hour urine specimens revealed that the nitrogen and dextrose urinary contents remained rather constant, with the greater constancy being noted when the glycosuria level was lowest.

Ligation of the parotid ducts had no significant effect on the dextrose or nitrogen level. Thus, it appears as though parotid duct ligation has no effect on carbohydrate tolerance in dogs unless the pancreatic factor is present.

Zimmet, Don, and H. Dubois-Ferrière, 1937. INFLUENCE DE L'AMYGDALECTOMIE SUR LE TAUX DE LA VITAMINE C DANS LA SALIVE HUMAIN [Influence of tonsillectomy on the amount of vitamin C in human saliva]. *Compt. rend. Soc. Biol. (Paris)*, 124: 246-274.

Determinations of the ascorbic acid levels of the saliva of one of the authors before and after tonsillectomy showed a marked drop in salivary ascorbic acid to follow removal of the glands. Further study in 2 individuals undergoing tonsillectomy confirmed the original findings. Daily ingestion of 500 mg. of ascorbic acid for a 10-day period produced no increase in the salivary level but did increase urinary elimination of ascorbic acid.

Zimmet, Don, and H. Dubois-Ferrière, 1937. VITAMINE C (ACIDE ASCORBIQUE) DANS LA SALIVE CHEZ L'ENFANT ATTEINT DE DIVERSES MALADIES INFECTIEUSES [Vitamin C (ascorbic acid) in the saliva of children with various infectious diseases]. *Compt. rend. Soc. Biol. (Paris)*, 124: 104-105.

Determinations were made of the ascorbic acid levels of the salivas of seventeen children, aged 6 to 14, who were suffering from a variety of infectious diseases. Results showed a marked drop in ascorbic acid levels of saliva from the average expected values of the age groups.

Zimmet, Don, and H. Dubois-Ferrière, 1937. LES VARIATIONS DU POUVOIR RÉDUCTEUR (VITAMINE C) DE LA SALIVE CHEZ L'HOMME SELON L'ÂGE [Variations of the reducing power (vitamin C) of the saliva of man according to age]. *Compt. rend. Soc. Biol. (Paris)*, 124: 103-104.

Determination was made of the ascorbic acid levels in the salivas of a large number of school

children, aged 4 to 16 years. Results tabulated by two-year groups show an increase in the ascorbic acid content of saliva with increase in age. The average values, increasing from 0.0376 mg./100 cc. in the 4 year-old group to 0.106 mg./100 cc. in the 16 year-old group, were found to show a further increase in the 16-20 year-old group to 0.130 mg./100 cc., the adult level.

Zipkin, Isadore, 1947. CITRIC ACID IN SALIVA. *Science (New York)*, 106 (2754): 343.

One hundred and eighty paraffin-stimulated saliva specimens from 15 men were analyzed for citric acid content; a modification of the method of Perlman, Lardy, and Johnson (*Indust. Eng. Chem., Anal. Ed.*, 16: 515) was used. The samples were collected four times daily for three days and averaged 0.61 to 2.04 mg. citric acid per 100 cc. saliva.

Zipkin, I., and F. J. McClure, 1948. EROSION AND CITRATE CONTENT OF SALIVA. *Jour. dent. Res.*, 27 (6): 739.

"Citric acid was determined in the stimulated saliva of 61 individuals without erosion, and in 60 individuals with erosion. The subjects varied from 27 to 68 years in age. The Perlman, Lardy, and Johnson modification was adapted to the analysis of citric acid in ten ML. of saliva. Analysis of the data by the method of multiple correlation has shown that the salivary citric acid content is significantly related to both the age of the individual and the degree of erosion. In a random selection of 83 individuals, grouped according to age, 21 per cent of the 27 to 39 age group, 32 per cent of the 40 to 49 age group, and 32 per cent of the group over 50 years of age showed some evidence of erosion. Preliminary analyses of human dentin and enamel for citric acid have indicated that dentin contains approximately one per cent citric acid and enamel contains approximately one-tenth per cent citric acid. Although teeth in the same mouth show a similar citric acid content, the amount varies considerably from one individual to another. Work is in progress to determine the citric acid content of dentin and enamel of sound and carious human teeth." (Complete paper.)

Zipkin, Isadore, and F. J. McClure, 1949. SALIVARY CITRATE AND DENTAL EROSION. PROCEDURE FOR DETERMINING CITRIC ACID IN SALIVA--DENTAL EROSION AND CITRIC ACID IN SALIVA. *Jour. dent. Res.*, 28 (6): 613-626.

Saliva samples of 121 individuals (60 with and 61 without) were studied for citric acid content; the method of citric acid determination of Pucher, Sherman, and Vickery, as modified by Perlman, Lardy, and Johnson [*cf. Indust. and Engin. Chem. (Anal. Ed.)* 16: 515. 1914], was used. Attempts were made to correlate the citrate values with dental erosion.

After stabilization of the citric acid in saliva by addition of H_2SO_4 , 10 ml. specimens of resting saliva yielded citric acid values varying from 0.010 mg. to 0.450 mg. The values of paraffin-stimulated salivas varied from 0.20 to 2.00 mg./100 cc.; the citric acid content increased slightly with the age of the individual, in the stimulated samples.

A positive correlation was indicated between the extent of erosion and the salivary citrate content.

Zipkin, I., E. H. Fath, and R. M. Stephan, 1953. THE CONCENTRATION OF CITRATE IN WHOLE AND PAROTID HUMAN SALIVA. Jour. dent. Res., 32 (5): 709.

A study was made of the citrate concentration in whole and parotid human saliva collected from 12 adult subjects. The decreasing order of citrate concentration was: parotid saliva (mean 1.47 mg), paraffin-stimulated non-fasting saliva (mean 1.05 mg), paraffin-stimulated fasting saliva (mean 0.52 mg), and extraparotid non-fasting saliva (mean 0.36 mg).

Zipkin, I., F. A. Bullock, and N. Mantel, 1957. THE RELATION OF SALIVARY SODIUM, POTASSIUM, SOLIDS AND ASH CONCENTRATION TO DENTAL CARIES EXPERIENCE IN CHILDREN, 5 TO 6 AND 12 TO 14 YEARS OF AGE. Jour. dent. Res., 36 (4): 525-531.

Whole, paraffin-stimulated saliva was collected from children aged 5 to 6 years (132 males, 106 females) and 12 to 14 years (188 males, 84 females). Least squares multiple regression equations were fitted relating the number of def or DMF teeth for each age and sex to the sodium and potassium concentrations, the log sodium-potassium ratio, and the per cent solids and ash. No significant relation was observed between the number of def or DMF teeth and the salivary constituents analyzed. No significant sex differences were observed in the 5- to 6-year old group, except for a slightly higher concentration of ash in the boys. In the 12- to 14-year-old group, the males showed a significantly higher sodium concentration, sodium potassium ratio, and per cent solids and ash than the females. No sex difference, however was observed in the potassium concentration. The sodium concentration, the sodium-potassium ratio and the per cent solids of the 12- to 14-year-old boys were significantly higher than those of the 5- to 6-year-old boys, whereas the potassium concentration was significantly lower. For girls, the only significant age change observed was in increase in the per cent solids. (Author's summary)

Zipkin, I., E. H. Fath, H. L. Wolff, and R. J. Fitzgerald, 1957. THE RELATION OF SALIVARY CITRATE TO DENTAL CARIES EXPERIENCE IN CHILDREN 12 TO 14 YEARS OLD. Jour. dent. Res., 36 (6): 823-827.

Whole, paraffin-stimulated saliva was collected from 144, 12- to 14-year-old children in 1950 and again in 1953. On the basis of the number of DMF teeth in 1950 the children were placed in either a low DMF (< 4 DMF teeth) or a high DMF category (> 12 DMF teeth for boys and > 14 DMF teeth for the girls). The increase in the number of DMF teeth in 1950-1953 was 2.6 for both the high and low DMF males, and 2.6 and 3.1 for the high and low females, respectively. Whole saliva was analyzed for citrate in 1950 and 1953, and streptococcus and lactobacillus populations were determined in 1953 only. The females showed a statistically significant inverse relation between salivary citrate concentration and prevalence of caries in both 1950 and 1953, whereas no such relation was seen in the male. Both the streptococcus and the lactobacillus counts were inversely related to the salivary citrate concentration in the female, whereas a similar relation was not seen in the male. (Author's summary)

Zipkin, I., E. R. Adamik, and H. A. Saroff, 1957. BOUNDARY ELECTROPHORESIS OF HUMAN PAROTID SALIVA. Proc. Soc. exper. Biol. Med., 95 (1): 69-71.

Six 60-ml. samples of parotid saliva were collected from the capped parotid duct in 5 individuals; the samples were concentrated by ultrafiltration at 4°C, dialyzed against 0.1 ionic strength veronal at pH 8.6, filtered, made up to 11 ml., and subjected to boundary electrophoresis. Protein analysis of duplicate, concentrated samples of parotid saliva before and after ultrafiltration, show no essential protein to be lost by ultrafiltration. Five distinct peaks were noted in every sample with 2 additional peaks appearing as shoulders in some samples. Two peaks accounted for 75% of the components; the major peak, comprising 50% of the fractions, had a mean mobility of $+3.0 \times 10^{-5}$ cm² sec.⁻¹ volt⁻¹. The fastest moving component had a mean mobility of -4.8×10^{-5} cm² sec.⁻¹ volt⁻¹.

Ziskin, Daniel E., and H. Hotelling, 1937. EFFECTS OF PREGNANCY, MOUTH ACIDITY, AND AGE ON DENTAL CARIES. Jour. dent. Res., 16 (6): 507-519.

A study of dental caries, the pH of unstimulated saliva, and age was made in 324 pregnant women with pregnancies ranging from one to 8 months. A similar study was made in 31 women who had never been pregnant. The mean value for the salivary pH of the pregnant women is 6.617, significantly less than that of the 31 non-pregnant women, 6.720. Within the pregnant group, the mean of 6.619 for the primiparae and that of the multiparae, 6.614, are without statistical significance. No relationship is found between the lower salivary pH and the lower incidence of caries among the pregnant women as compared to the non-pregnant.

Zol'nikova, N. K., 1941. IZMENENIE OTDEL'NYKH AZOTISTYKH FRAKTSII V SMESHANNOI SLIUNE PODCHEL-IUSTNOI I POD"IAZYCHNOI ZHELEZ PRI ISTOSHCHENII I V PERIOD VOSSTANOVLENIYA [Changes in the different fractions of mixed saliva of the submaxillary and sublingual glands during exhaustion and during the period of restoration]. Fiziol. Zhur. SSSR, 30 (5): 642-646.

Changes in salivary nitrogen content produced by prolonged salivary stimulation were studied in 14 experiments in 4 fistulated dogs. Determinations were made of the nitrogen content of the saliva and of salivary mucin, before and for the 7 to 10 days after saturation feedings, in salivary samples collected while feeding three 1 gm. portions of rusk every 15 seconds for 5 or 7 minutes. Similar determinations were made after a 5 minute interval when the saturation feedings were administered without interruption until refusal; water was given every 30 minutes. Results show that salivary mucin contains 86 to 89% of the total salivary nitrogen, which ranges from 45.3 to 50.9 mg.%. Results of the salivary exhaustion experiments in one dog showed that uninterrupted secretion for a period of 3 hours, 9 minutes to produce a 78% drop in total salivary nitrogen and a drop of 88% in that of salivary mucin; little change was found in the nitrogen content of other salivary constituents. Prolonged secretion in another dog, for a 1 hour, 52 minute period, produced a 47% drop in total salivary nitrogen and a 54.6%

drop in mucin nitrogen. The variable decrease in the nitrogen content of mucous saliva was found to be due to the reduction in mucin, incident to prolonged secretion, which parallels or relatively exceeds the drop in total nitrogen; salivary mucin may completely disappear if secretion is sufficiently prolonged. An irregular fluctuation was found in the nitrogen content of other salivary constituents. The recovery period after prolonged salivary secretion is characterized by salivary increases in both total nitrogen and mucin content which reach normal levels after 4 to 5 days; this increase may continue to above normal levels for several days. The nitrogen content of other salivary constituents continue to show irregular fluctuations until recovery is attained.

Zunz, Edgard, and F. Jourdan, 1934. EFFETS RESPIRATOIRES ET EXCITOSECRETEURS DU DIETHYL-AMINOMETHYLBENZODIOXANE [Respiratory and secretagogic effects of diethylaminomethylbenzodioxane]. Compt. rend. Soc. Biol. (Paris), 115: 1378-1380.

Subcutaneous injection of diethylaminomethylbenzodioxane (F883) in the rooster, cat, and dog resulted in abundant salivation, accelerated respiration, and muscular weakness in these animals. Subcutaneous injection of atropine immediately stopped the salivation thus evoked in the dog and in the cat. Intravenous injection of 5 to 10 mg./kg. of F883 in the dog, under ether or chloralose anesthesia, produced abundant salivation which was not affected by section of the chorda tympani or of the cervical vago sympathetic trunk. The drug thus appears, like ergotamine, to affect the peripheral parasympathetic secretory system.

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